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**THE SMALL VERTEBRATE FAUNA  
(RODENTS, INSECTIVORES, AND REPTILES)  
OF ŠANDALJA 1A (ISTRIA, CROATIA)**

**FAVNA MALIH VRETENČARJEV  
(GLODALCI, ŽUŽKOJEDI IN PLAZILCI)  
ŠANDALJE 1A (ISTRA, HRVATSKA)**

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**Izvleček**

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**Jean-Pierre Aguilar & Jean-Yves Crochet & Jacques Michaux & Andrej Mihevc & Maja Paunović:  
Favna malih vretenčarjev (glodalci, žužkojedi in plazilci) Šandalje 1A (Istra, Hrvaška)**

Pod lokacijo Šandalja 1A je opisana spodnje srednje pleistocenska favna malih vretenčarjev, ki vsebuje ostanke glodalcev, žužkojedov in plazilcev. Kostne breče so bile najdene leta 1999 v kamnolomu Šandalja pri Puli, njihova natančna lega v primerjavi znanim kostnim brečam Šandalje 1 pa ni natančno znana. Kljub temu, njena izpričana manjša - Biharijska starost - govori v prid manjši starosti favne velikih sesalcev Šandalje 1 in z njo povezanim prodnjakom.

**Ključne besede:** paleontologija, rodentia, insectivora, reptilia, pleistocen, Šandalja, Hrvaška.

**Abstract**

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551.791:568/569(497.5)

**Jean-Pierre Aguilar & Jean-Yves Crochet & Jacques Michaux & Andrej Mihevc & Maja Paunović:  
The small vertebrate fauna (Rodents, Insectivores, and Reptiles) of Šandalja 1A (Istria, Croatia)**

Is described under the name of Šandalja 1A, a Lower to Middle Pleistocene fauna of small vertebrates including rodents, insectivores and reptiles. Extracted from a bone breccia found in 1999 in the Šandalja quarry near Pula, its accurate localization with respect to the previously known bone breccia of Šandalja 1 is not known. Nevertheless this dating - a Biharian age - is congruent with the younger age now advocated for the fauna of large mammals of Šandalja 1 and its associated chopper.

**Key words:** Palaeontology, Rodentia, Insectivora, Reptilia, Pleistocene, Šandalja, Croatia.

## INTRODUCTION

In the quarry of Šandalja, located 4 km from the town of Pula (Istria, Croatia), a bone breccia was discovered in 1961. Characterized by a rich fauna of large mammals, a chopper was also found, and the assemblage received a Middle or Late Villafranchian age (Malez, 1968, 1975; Paunović 1984). In 1981 Lumley compared the Šandalja 1 with Vallonet because of the similarity of the Šandalja's 1 chopper and industry from Vallonet, as well as of the faunal assemblages, placing both sites in the Günz and Günz/Mindel period dated from 1 500 000 to 700 000 years B.P. In 1992 Malez et al. described the equid sample from Šandalja 1 which consists of only two distal metapodia, astragalus and calcaneum, one phalanx and a magnum as *Equus* sp. and compared the remains also with Middle Pleistocene equids from Mosbach and Tiraspol finding no big differences. The faunal assemblage of the Šandalja 1 most probably belongs to the Late Early Pleistocene or perhaps to the Middle Pleistocene ie. Biharian similarly to the other faunal assemblages from the bone breccias found in Croatia. Today, this fossiliferous locality is compared to the Vallonet in France (Paunović, 2000) and an age of 1 My (Tautavel Conference, 2000) is thus proposed.

In October 1999, in the same quarry, new blocks of a bone breccia similar in texture to the one described by Malez (1975) were sampled but the relative location of the old and new site remains vague. The previously found fauna and site was named Šandalja 1, and the one discovered in 1999, Šandalja 1A. It has been possible to collect small vertebrates (rodents, insectivores and reptiles) from the new breccia. The rodents of Šandalja 1A indicate a Lower to Middle Pleistocene age. A more intensive prospecting of the quarry as well as a revision of the fauna of Šandalja 1 will make it possible to know if these two assemblages are identical or slightly different in age.

## 1 - FAUNA OF ŠANDALJA 1A

### A - Rodents

Measurements are expressed in mm

*Apodemus sylvaticus* (Fig. 1a to 1d)

Material: five incomplete mandibles, four maxillaries including two complete ones, and several isolated teeth, SA 1A n°67 to 133

#### Measurements

	n	L min	L moy	L max	L min	L moy	L max
m1	19	1,75	1,88	2,01	1,05	1,12	1,24
m2	18	1,19	1,28	1,40	1,03	1,10	1,23
m3	1		1,06			0,93	
M1	18	1,75	1,94	2,15	1,19	1,27	1,37
M2	14	1,21	1,32	1,46	1,12	1,17	1,23
M3	2	0,86		0,91	0,84		0,89

These molars have all the characteristics of the species *Apodemus sylvaticus*. Many Pleistocene populations have been described by Pasquier (1974). The average size of these molars is larger than that of the Croatian population from Podumci 1 (Malez & Rabeder, 1984) and French populations of the end of the Middle Pleistocene (Pasquier, 1974). On the other hand, the size is similar to the one of the Slovenian locality of Črni kal 2 and 3 allocated to the Middle Pleistocene (Aguilar et al. 1998).

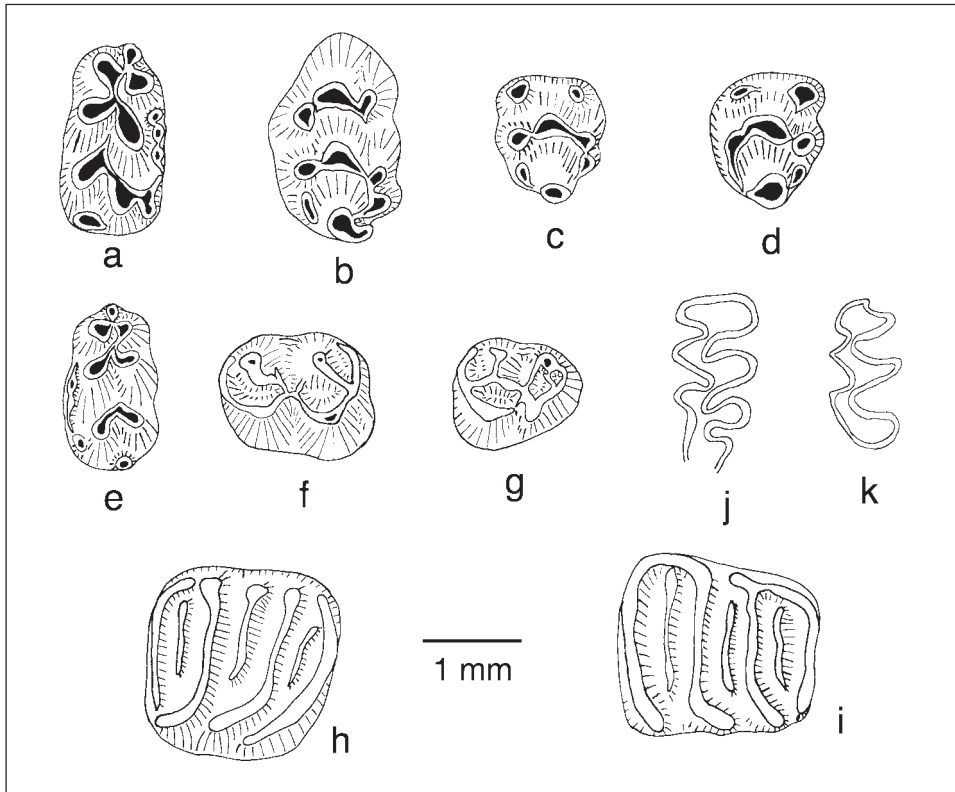


Fig. 1: Rodents of Šandalja IA - *Apodemus sylvaticus*: 1a - m1 d. SA IA n°111 ; 1b - M1 s. SA IA n° 76; 1c - M2 s. SA IA n° 92; 1d - M2 d. SA IA n° 100 - *Apodemus cf. microps*: 1e - m1 s. SA IA n° 66 - *Allocrietus bursae*: 1f - M2 d. SA IA n° 63; 1g - M3 s. SA IA n° 65 - *Glis sp.*: 1h - M1 d. SA IA n°36; 1i - m1 d. SA IA n° 20 - *Clethrionomys cf. glareolus*: M3 SA IA n° 134 - *Arvicolid cf. Microtus*: m3 SA IA n° 135

Sl. 1: Glodalci iz Šandalje IA - Rodents of Šandalja IA - *Apodemus sylvaticus*: 1a - m1 d. SA IA n°111 ; 1b - M1 s. SA IA n° 76; 1c - M2 s. SA IA n° 92; 1d - M2 d. SA IA n° 100 - *Apodemus cf. microps*: 1e - m1 s. SA IA n° 66 - *Allocrietus bursae*: 1f - M2 d. SA IA n° 63; 1g - M3 s. SA IA n° 65 - *Glis sp.*: 1h - M1 d. SA IA n°36; 1i - m1 d. SA IA n° 20 - *Clethrionomys cf. glareolus*: M3 SA IA n° 134 - *Arvicolid cf. Microtus*: m3 SA IA n° 135

*Apodemus cf. microps* (Fig. 1e)

Material : 1 m1 (1,66 x 0,96) SA 1A n° 66

This molar differs from those of *A. sylvaticus*, by its small size and it is characterized by a reduced outer cingular margin. It is referred to *A. microps* which has been recognized in Kamik (Kowalski, 1960).

*Allocricetus bursae* (Fig. 1f-g)

Material : 1 mandibule with m1-m3 (2,00 x 1,16; 1,54 x 1,32; 1,56 x 1,18); 2 m2 (1,58 x 1,29; 1,54 x 1,25); 1 m3 (1,58 x 1,13) ; 3 M2 (1,57 x 1,29; 1,54 x 1,35; 1,50 x 1,25); 2 M3 (1,23 x 1,07; 1,29 x 1,11). SA 1A n° 57 to 65

The size of these molars is a little smaller than the size observed in *A. ehiki*. It enters the size variation known for populations of *A. bursae* and *A. croaticus* of Pleistocenes age described from Croatia : Tatinja draga and Razvodje (Paunović & Rabeder, 1996). The two M3 seem less reduced in size than those of *A. croaticus* and a small mesoloph is still present on the M2. These characteristics would bring this small population close to the species *Allocricetus bursae*. This species was formerly recognized in the locality of Šandalja 1 (Malez, 1975).

*Clethrionomys cf. glareolus* (Fig. 1j)

Material : 1 M3 (1,74 x 0,88) SA 1A n° 134

This rooted tooth shows the typical round outline of the salient lingual angles and backward curved buccal synclines.

Arvicolid cf. *Microtus* (Fig. 1k)

Material : 1 m3 (1,45 x 0,78) SA 1A n° 135

This unique molar devoid of roots is of small size, and shows the characteristically confluent T1 and T2 triangles.

*Glis* sp. (Fig. 1h-i)

Material : isolated teeth (see table below) SA 1A n° 20 to 56

	n	L min	L moy	L max	L min	L moy	L max
d4	2	1,21		1,24	1,03		1,05
p4	2	1,32		1,37	1,32		1,35
m1	4	1,88	1,98	2,06	1,71	1,79	1,87
m2	6	2,02	2,07	2,12	1,88	1,93	2,01
m3	4	2,01	2,09	2,20	1,66		1,92
D4	1		1,11			1,33	
P4	1		1,42			1,62	
M1	5	1,84	1,87	1,91	1,89	1,95	2,03
M2	9	1,83	1,93	2,03	2,05	2,13	2,22
M3	3	1,50	1,62	1,74	1,80	1,84	1,89

Morphology and size of these teeth are comparable with those known for the much larger assemblage described from the Slovenian site of Velika Pirešica (in prep).

### **B - Insectivores:**

The remains of insectivores extracted from Šandalja 1A are scarce but their interest for the dating of the fauna is significant. They are attributed to 4 taxa. Teeth measurements are taken according to Rümke (1985, p. 25, Fig. 4) for Talpidae and to Reumer (1984, p. 7, Fig. 4) for Soricidae. Measurements are given in millimeter. Morphological terms are borrowed from these two authors.

#### Talpidae

##### Genus *Talpa*

##### *Talpa fossilis* or *europaea*

The determination of this form in Šandalja 1A is based on the discovery of two isolated teeth: 1 m2 dext. (2,53 X 2,03) and 1 m3 dext. (1,98 X 1,16).

The species *T. fossilis* Petényi, 1864 and *T. europaea* Linné, 1758 are known to be difficult to separate according to tooth morphology. Some authors assert the synonymy of the two taxa whereas others regard them as good chronological index species. In this case, *T fossilis* is used for the lower Pleistocene time interval (Crochet & Michaux, 1981, p.135).

The main interest of the discovery of a mole is environmental as *Talpa* indicates rather soft but not too clayey soils, and open space.

#### Soricidae

##### Subfamily Crocidurinae

##### *Crocidurina kornfeldi* Kormos, 1934

Material : 1 right P4, 1 right M2 (highly worn; with a broken hypocone) and 1 left well preserved m2 (1,55 x 0,92).

The P4 has a broken parastyle, no parastylar point, and a weakly individualized protocone. The lack of hypocone is to be noticed. Cingulums are reduced and the posterior notch is not very deep but the latter character is variable among populations (Reumer o.c., p.21, pl. 1).

Referring to Reumer's recent critical revision of the group (o.c.), the three specimens are attributed to *C kornfeldi*. According to Reumer *C kornfeldi* is confined in the Upper Villanyan (Kislang phase) and Lower Biharian (Betfia phase) in spite of its recognition in a few older localities.

##### Subfamily Soricinae

##### *Drepanosorex* Kretzoi, 1941

##### *Drepanosorex* sp.

A fragmentary right maxillary (with the two last unicuspid teeth and the P4 which lacks the postero-labial part) can be referred to *Drepanosorex* Kretzoi 1941 because of the coloured tips of the teeth (exodaenodonty). But the size of the Šandalja 2 specimen (P4: (1,31) X 1,24; A3 0,5 X 0,57; A2 : 0,5 X 0,61) is too weak for an attribution to any species referred to this genus.

Besides some isolated mentions in a few Pliocene localities, the genus is well represented in Villanyan and Biharian faunas.

Soricid indet.

One highly worn right m2 (1,62 X 0,95) cannot be referred to above mentioned taxon. As it is not possible to see if the tip of the cones are coloured because of the wear, the tooth is determined as Soricidae indet.

### C - Reptiles:

Among the microvertebrate remains, only 16 pieces of reptiles can be determined (table 1): they belong to lizards (*Ophisaurus pannonicus*, *Archaeolacerta* and *Lacerta*) and snakes (*Elaphe*).

Inv. Nr.	SPECIES	DESCRIPTION
Sa 1A-1	<i>Archaeolacerta</i> sp.	dermal plate, dorsal
Sa 1A-2	<i>Archaeolacerta</i> sp.	dermal plate, dorsal
Sa 1A-3	<i>Archaeolacerta</i> sp.	dermal plate
Sa 1A-4	<i>Ophisaurus pannonicus</i>	dermal plate
Sa 1A-5	<i>Lacerta</i> sp.	dermal plate
Sa 1A-6	Serpentes indet.	vertebra
Sa 1A-7	<i>Lacerta</i> sp.	dentary
Sa 1A-8	<i>Lacerta</i> sp.	dentary
Sa 1A-9	<i>Lacerta</i> sp.	dermal plate
Sa 1A-10	<i>Lacerta</i> sp.	dermal plate
Sa 1A-11	<i>Elaphe</i> sp.	vertebra
Sa 1A-12	<i>Elaphe</i> sp.	vertebra
Sa 1A-13	Serpentes indet.	vertebra
Sa 1A-14	Serpentes indet.	vertebra
Sa 1A-15	Serpentes indet.	vertebra
Sa 1A-16	<i>Elaphe</i> sp.	vertebra

These remains of reptiles testify to the existence of a karstic environment with mixed vegetation (forest and maquis).

## AGE OF THE MICROFAUNA OF ŠANDALJA 1A

The weak representation of Arvicolids does not allow an accurate dating. However the presence the *Clethrionomys* with an evolved tooth morphology the rootless vole of the genus *Microtus* indicate the Biharian, a time interval ranging between -1,6 and -0,6 My according to the calibration suggested by Nadachowski (1990). The estimated age on the basis of these rodent is more recent than the classical localities of the "Massif Central" in France which are referred to the mammalian zone MN 16/17 (that is they are Villanyan) (de Bruijn et al. 1992; Torre et al. 1992), their ages are close to -2,5 My.

The remaining rodents are not useful for a dating. *A. bursae* is known from the end of the Villanian up to the Biharian (Nadachowski, 1990). The fieldmouse species *Apodemus sylvaticus*, *A. flavicollis* and *A. microps* are known in Poland in Lower Biharian (Nadachowski, 1989, 1990) localities, but also in of Croatia (Malez & Rabeder, 1984; Paunović & Rabeder, 1996) as well as in Slovenia (Aguilar et al. 1998). The dormouse *Glis* sp. is only known up to now in Slovenian sites (Aguilar et al. 1998). The insectivores recognized in Šandalja 1A are known in the Villanian and Biharian.

The composition of the rodent fauna of Šandalja 1A is similar to the ones of the Slovenian localities of Črni kal 2 and 3 which are referred to the Middle Pleistocene (Aguilar et al, 1998). Although the breccia of Šandalja 1 and Šandalja 1A are very similar (great amount of pieces of bones of large mammals) it is difficult to say that they are contemporaneous because their exact origin is no more known. Nevertheless, it is worth to point that the two species *Allocricetus bursae* and *Mimomys* sp. recognized in Šandalja 1 do not contradict the age advocated for the fauna of Šandalja 1A. Preparation of newly collected blocks of breccia in Šandalja 1A at the Institute of Quaternary Paleontology and Geology in Zagreb as well as a revision of the fauna of Šandalja 1 will undoubtedly bring new data to solve this question, more fossils of voles are urgently needed. If the Šandalja I fauna is effectively younger than estimated by Malez (1968), the two faunas of Šandalja I and IA may be contemporaneous and thus the chopper would be Biharian in age.

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## FAVNA MALIH VRETENČARJEV (GLODALCI, ŽUŽKOJEDI IN PLAZILCI) ŠANDALJE 1A (ISTRA, HRVAŠKA)

### Povzetek

V jami v kamnolomu Šandalja pri Puli je bila leta 1961 odkrita kostna breča s kostmi velikih sesalcev. Najden je bil tudi prodnjak (Malez, 1968, 1975; Paunović, 1984). Danes Šandaljo primerjajo z nahajališčem Vallonet v Franciji (Paunović, 2000), njegova starost pa naj bi bila okrog 1 Ma.

V oktobru 1999 so bili v istem kamnolomu najdeni bloki kostne breče s podobno teksturo, kot jo je opisal Malez (1975), vendar pa nahajališče blokov ni natančno znano, zato oznaka Šandalja 1A. V breči smo lahko zbrali drobne vretenčarje (glodalce, žužkojede in plazilce). Glodalci iz teh breč kažejo spodnjo do srednje pleistocensko starost breče.

Slaba zastopanost arvicolidov ne omogoča natančnega datiranja, vendar pa *Clethrionomys* z razvito zobno morfologijo in voluharica vrste *Microtus* kaže na Biharijsko starost oziroma časovni interval med -1,6 Ma in 0,6 Ma.

Ostanki glodalcev niso primerni za datiranje. *A. bursae* je znan za Villanian in Biharian (Nadachowski, 1990). Vrste poljskih miši *Apodemus sylvaticus*, *A. flavicolis* in *A. microps* so znane na Poljskem že v spodnje Biharianskih nahajališčih (Nadachowski, 1989, 1990) na Hrvaškem (Malez & Rabeder, 1984; Paunović & Rabeder, 1996) in v Sloveniji (Aguilar et al. 1998). Polhi, *Glis* sp. so do sedaj znani le iz slovenskih nahajališč (Aguilar et al. 1998). Sestava favne glodalcev v Šandalja 1A je podobna nahajališčema Črni kal 1, Črni kal 2 in Črni kal 3, ki so srednje pleistocenske starosti (Aguilar et al, 1998).

Čeprav sta si kostni breči Šandalje 1 in Šandalje 1A zelo podobni (velik del kosov kosti velikih sesalcev) je težko reči, ali sta sočasni, saj natančne lokacije breč niso več znane. Kljub temu pa je vredno poudariti, da vrsti, *Allocricetus bursae* in *Mimomys* sp. iz Šandalje 1, ne nasprotujeta starosti, ki jo kaže favna iz Šandalje 1A.

Preparacija novih blokov kostne breče iz lokacije Šandalja 1A na Inštitutu za kvartarno paleontologijo in geologijo v Zagrebu kot tudi revizija favne iz Šandalje 1 bo nedvomno pomembno prispevala k natančnejšemu določanju starosti favne, predvsem s pomočjo voluharic. Če je favna Šandalja 1 mlajša kot predpostavlja Malez (1968), sta favni Šandalje 1 in Šandalje 1A lahko sodobni in je prodnjak Biharijski po starosti.