

A LOWER SARMATIAN SMALL-SIZED DOLPHIN (MAMMALIA: CETACEA, ODONTOCETI) AT BASARABI (SUCEAVA DISTRICT)

CODREA A. Vlad, RĂȚOI B. Gabriel, HIRU Alexandru, URSACHI Laurențiu

Abstract. In the Lower Sarmatian (Vollhynian) deposits exposed at Basarabi (Suceava District) on the Moldavian Platform (eastern Romania), the presence of a small sized dolphin is documented by a fragmentary isolated ulna. The bone was recovered from a sandstone bed bearing also other indeterminate bone fragments and Vollhynian molluscs belonging to the Șomuz Formation, Arghira Member, just under the Arghira II lithological and biostratigraphical level. This specimen is herein assigned to Kentriodontidae indet. This find documents better the presence of this group of Odontoceti in eastern Romania. Their presence is not surprising, because the Lower Sarmatian palaeogeography in Romania, when the Carpathians were still an archipelago in the Paratethys Sea, allowed marine faunal interchanges with the inner Carpathians area, unconfined by topographic odds.

Keywords: cetaceans, Odontoceti, Middle Miocene, Moldavian Platform, Romania.

Rezumat. Un delfin (Mammalia: Cetacea, Odontoceti) din Sarmatianul inferior de la Basarabi (județul Suceava). În depozitele sarmatian inferioare (Volhynian) care apar la zi la Basarabi (județul Suceava) în Platforma Moldovenească (estul României), prezența unui delfin de mărime mică este dovedită de un fragment de ulna, descoperit izolat. Osul a fost recuperat dintr-un strat de gresie care mai conținea și alte fragmente de oase indeterminabile, precum și de moluște volhiniene și care revine Formațiunii de Șomuz, Membrul de Arghira, fiind localizat imediat dedesubtul nivelului litologic și biostratigrafic Arghira II. Specimenul este aici atribuit la Kentriodontidae indet. Această descoperire documentează mai bine prezența acestui grup de Odontoceti în România răsăriteană. Prezența lor nu este însă surprinzătoare, deoarece paleogeografia Sarmatianului inferior din țara noastră când Carpații formau un arhipelag în Marea Paratethys, a permis schimburi faunistice neîngrădite de vreo barieră topografică cu aria intracarpatică.

Cuvinte cheie: cetacee, Odontoceti, Miocen mediu, Platforma Moldovenească, România.

INTRODUCTION

Fossil cetaceans are relatively few mentioned in the geological references of Romania. The majority refers to isolate bones – in majority vertebrae - found either in the Middle Miocene deposits (mainly Sarmatian) or reworked into recent river alluvia, from the same deposits (e.g. KOCH, 1899; SIMIONESCU, 1931; NICOLAESCU, 1933; CODREA, 1996, 2006, 2008).

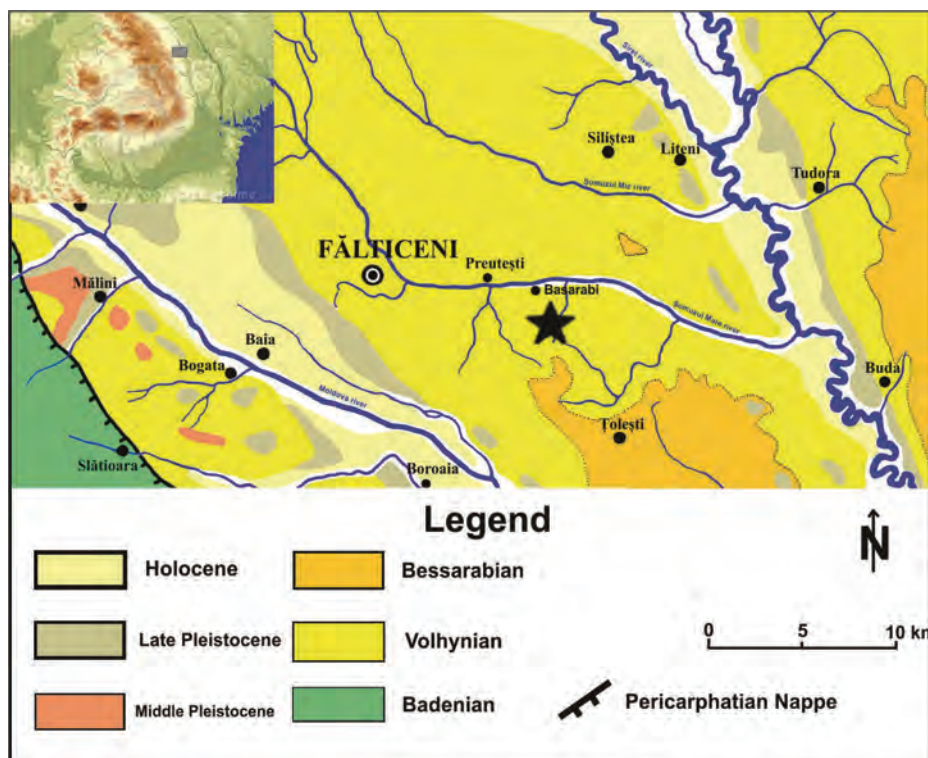


Figure 1. Geological map of Basarabi area (modified after MACAROVICI, 1964).

Among these fossil cetaceans, the dolphins are frequent. This study concerns a Middle Miocene (Early Sarmatian) dolphin bone, found in the deposits cropping out in Moldova (eastern Romania), in Suceava District at Basarabi. This locality is located 12 km East from Fălticeni (Fig. 1).

From the geological point of view, this area is part of the Moldavian Platform (i.e. a part of the East European Platform). In this platform, the youngest sedimentary megasequence (Middle Miocene-Late Miocene; IONESI, 1994) includes Sarmatian rocks accumulated in the Forebulge depozone (GRASU et al., 2002). The ruditic-arenitic “lithofacies” exposed at the contact with the Carpathian Orogene outlined by several geologists that studied the Sarmatian in the platform (e.g. IONESI, 1994; IONESI et al., 2005) would represent the result of the Carpathian Foredeep sedimentary infilling, followed by gradual emergence and establishment of shallow water depositional systems. The Sarmatian deposits exposed at Basarabi on Manolea Hill area, were studied a half century ago of by MACAROVICI (1964). He pointed out that the Early Sarmatian (Volhynian), documented by several outcrops bearing specific molluscs, is present North of the Șomuzului Mare Valley (Fig. 1).

The deposits from Basarabi are located in the transition area between the distal Foredeep – Forebulge (GRASU et al., 2002). One of its main specificity is the presence of the marker rock levels represented by limestones and sandstones sedimented in shallow-water environments.

During a field mission in 2013 at Basarabi, one of us (A. H.) discovered a limb arm bone belonging to a small-sized dolphin in the Lower Sarmatian rocks cropping out on Pârâul lui Gheorghe (Gheorghe’s Brook). These deposits are exposed in a discontinuous matter, between 309 and 321 meters in altitude. According to IONESI (2006), these deposits belong to the Șomuz Formation, Arghira Member.

IONESI (1968) outlined in the area between the Siret and the Moldova valleys eight sandstone (limy and oolitic sandstones) levels as lithologic and biostratigraphic markers, named: Pătrăuți I, Pătrăuți II, Burdujeni, Arghira I, Arghira II, Hârtop I, Hârtop II, Hârtop III, Nigotești. The dolphin bone originates in a sandstone bed located just under Arghira II (Figs. 2, 3). Apart this fossil, this bed yielded also several other indeterminate bone fragments, as well as various Volhynian mollusc shells. Among the marker mollusc taxa indicating the Early Sarmatian (Volhynian) are: *Plicatiforma plicata* (Eichwald), *P. latusulca* (Münster), *Obsoletiforma vindobonense* (Parsch), *Ervilia dissita* (Eichwald), *Abra reflexa* (Eichwald), *Mactra (Podolimacra) eichwaldi* (Laskarev), *Tapes tricuspis* (Eichwald), *Potamides mitralis* (Eichwald), *P. nimpha* (Eichwald), *P. bicostatus* (Eichwald) and *P. disjunctus quadricinctus* (Sieber).

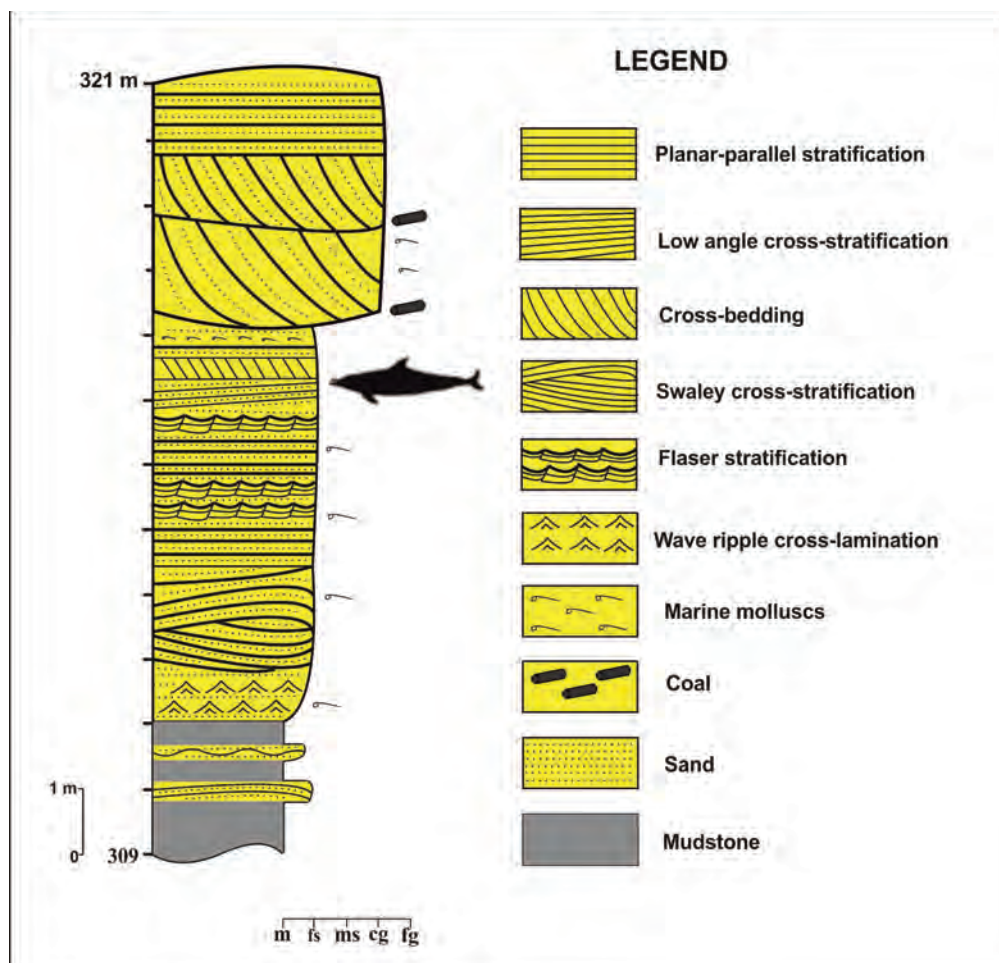


Figure 2. Lithological log on the Gheorghe’s Brook outcrop.

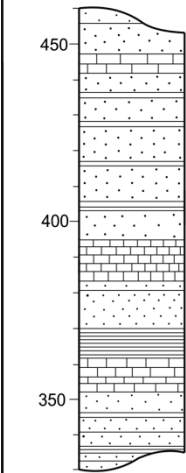
LITHOSTRATIGRAPHY	BIOSTRATIGRAPHY				AGE
	MOLLUSCS	BIOZONE	FORAMINIFERA	BIOZONE	
 <p>Hârtop I 450 Arghira II 400 Arghira I 350</p>	<i>Potamides disjunctus</i> <i>Dorsanum duplicatum</i> <i>Plicatiforma plicata</i> <i>Plicatiforma plicatofittoni</i>	Potamides and Plicatiforma	<i>Ammonia beccarii</i> <i>Quinqueloculina consobrina</i> <i>Spirolina mariae</i>	<i>Ammonia beccarii</i> <i>Quinqueloculina consobrina</i>	VOLHYNIAN
	<i>Plicatiforma plicata</i> <i>Plicatiforma latisulca</i>	Plicatiforma and Mactra	<i>Elphidium rugosum</i> <i>Ammonia beccarii</i> <i>Quinqueloculina consobrina</i>	<i>Elphidium rugosum</i>	
	<i>Potamides mitralis</i> <i>Potamides bicostatus</i> <i>Potamides nimpha</i>	Potamides	<i>Porosonion subgranosus</i>		

Figure 3. Lithostratigraphy and biostratigraphy of the Volhynian deposits between the Siret and the Moldova valleys (modified after IONESI, 1968), marking the stratigraphic location of the dolphin bone.

IONESI (2006) based on previous research (IONESI, 1968, 1994) outlined three mollusc assemblage biozones: i. the assemblage-zone with *Inaequicostata pia* and *I. gleichenbergense* (Late “Buglovian”-Early Volhynian); ii. the assemblage-zone with *Ervilia dissita* and *Mactra eichwaldi* (Volhynian); the assemblage-zone with *Potamides mitralis* and *P. nimpha* (Volhynian).

The sedimentology refers to sedimentary facies indicative of a coast-type depositional realm with low energy, possibly deltaic, dominated by waves. BRÂNZILĂ et al. (1995) who studied the lithology of the deposits from Arghira (Muscalului Brook) focused on four samples of rocks collected under and above the Arghira I level. Based on the morphoscopic and exoscopic observations on the quartz grains, they reconstructed a succession of the transport environments, indicating irregular sedimentary process.

IAMANDEI et al. (2008) carried out in the area palaeobotanical studies and found in Arghira Member evidence of coniferous forests with *Cupressaceae*.

PILLER & HARZHAUSER (2005) pointed out that the evolution of the Sarmatian Sea is subdivided at least into a short Early Sarmatian *s.s.* (Volhynian) part with normal marine - in marginal areas probably mixohaline - waters, and a longer Late Sarmatian *s.s.* (Bessarabian) part of normal marine to occasional hypersaline conditions. Such distributions of salinities could be the same in this part of the Moldavian Platform.

MATERIAL AND METHODS

The single specimen documenting the presence of dolphins in the Lower Sarmatian (Volhynian) locality Basarabi is a proximal fragment of a left ulna. The fossil is curate at the Museum of the Transylvanian Basin, at Babeș-Bolyai University in Cluj-Napoca.

The bone was extracted from the matrix rock by classical mechanical tools (chisel and hammer), than reinforced by a professional polymer. Photographs of the studied specimen were taken with a Nikon D-7000 camera and a 50mm f1.8 lens and processed in Photoshop in order to sharpen the bone texture and also to create the accompanying line drawings.

The terminology and measurements follow KAZÁR & VENCZEL (2003) and KAZÁR et al. (2004).

Institutional abbreviations: Museum of the Transylvanian Basin, Babeș-Bolyai University Cluj-Napoca – MTB; Țării Crișurilor Museum Oradea – TCM.

RESULTS

SYSTEMATIC PALAEOLOGY

Cetacea Brisson, 1762

Odontoceti Flower, 1869

Delphinida Muizon, 1984

Delphinoidea Gray, 1821

Kentriodontidae Slijper, 1936

Kentriodontidae indet. (Fig. 4 a.)



Figure 4. Kentriodontidae ulnae from the Early Sarmatian (Volhynian) of Romania, in lateral views: a – Basarabi (MTB V465); b – Cluj-Napoca (MTB 14943); c – Tășad (TCM 22404).

Referred specimen: from Basarabi, Suceava District, Romania; MTB V465.

Formation and geological age: Early Sarmatian (Volhynian).

Description of the dolphin bone from Basarabi: The bone is damaged, the whole distal part is broken – this damage occurred during the extraction of the bone from the matrix -, as well as a part of the olecranon process. The epiphysis completely ankylosed to the shaft is indicative of an adult specimen. In spite of the damages, one can notice the strong mediolaterally flattening of the bone, the rather straight anterior and posterior margins, the heart-shaped articular facet with the humerus as well as the ellipsoidal articular facet with radius. The transverse section of the shaft has an elliptic elongate outline. On the anterior margin of the bone a well-marked longitudinal groove is present, while the posterior one is a sharp edge.

Measurements (mm):

	Basarabi MTB V465	Cluj-Napoca MTB 14943	Tășad TCM 22404
Anteroposterior extension of the proximal end of ulna	+ 30.5	25.5	-
Anteroposterior extension of the articular facet of the ulna for the humerus	16.0	11.5	13 (estimated)
Mediolateral width of the proximal epiphysis	16.8	-	-
Minimum anteroposterior width of the shaft	22.0	18.2	-

DISCUSSION

The bone morphology is very similar to the ulna described by KAZÁR et al. (2004) for the Lower Sarmatian (Volhynian) dolphins collected from the former Iris open-pit in Cluj-Napoca, but also to the one from Tășad (Bihar District; KAZÁR & VENCZEL, 2003). Compared to the ulnae originating from these localities, the one from Basarabi is larger.

The fossils from both localities Cluj and Tășad are more reliable than the bone from Basarabi from a systematic point of view, as long as they are associated with more diagnostic bones as periotics or humeri. If in Cluj an assignation of the fossils to *Atocetus (?) fuchsii* (Brandt 1873) based just on the mentioned bones was possible, as in Basarabi such bones miss, we assign this fossil to Kentriodontidae indet. These small sized dolphins had a largely distribution than presumed before in the Paratethys Sea realm of Romania. Apart Cluj-Napoca (located in the

Transylvanian Basin) and Tășad (Beiuș Basin), these dolphins are also reported from the Volhynian of Domașnea (Caransebeș-Mehadia Basin, in the Southern Carpathians; CODREA & SEREȚEAN, 2004), and probably such fossils will be also further found in other Neogene localities from the inner Carpathian region. East from the Eastern Carpathians, the presence of Kentriodontidae is rather clearer outside Romania, in Republic of Moldova or Ukraine. But either the fossils reported by SIMIONESCU (1943) and later by KIRPICHNIKOV (1954) from the Middle Sarmatian *s.l.* (Bessarabian; MACAROVICI & OESCU, 1942) limestones of Chișinău, assigned to the distinct species *Sarmatodelphis moldavicus* Kirpichnikov 1954 (KAZAR & GRIGORESCU, 2005), or the ones described from the Volhynian of Podolia in Brykov by KUDRIN & TATARINOV (1965) as *Microphaocaena podolica* Kudrin & Tatarinov 1965 refer mainly to skull remains without associated limb bones, therefore a direct comparison with Basarabi cannot be done.

Inside some other reports of a few previous palaeontologists focused on the Sarmatian Odontocetes one can notice the tentative in outlining some species. MACAROVICI & ZAHARIA (1968) mentioned vertebrae assigned to “*Chamsodelphis cf. fuchsii* Brandt”, 1873 collected from the Volhynian marls cropping out on Ghireni Brook at Ghireni or at Cordăreni (Botoșani District) and Bessarabian clay from Ciurea (Iași District), and to “*Phocaena euxinica* Nordman”, 1860 found in the Bessarabian clay (*Cryptomactra* Formation) from Rînghilești and in the Volhynian clay of Stăncești (Botoșani District). A couple of decades later, IONESI & GALAN (1988) described from the Volhynian (Darabani-Mitoc Clay) de Darabani (Botoșani District), several vertebrae (thoracicals, lumbar, caudals), rib fragments and phalanges, assigned to *C. fuchsii*. In spite of these students’ insistence, none of these fossils is enough indicative for a species’ assignment and all have to be restricted either to Odontoceti indet., or in some cases, at the very most to Kentriodontidae indet.

The bone was found isolate *in situ*, inside the rocks already mentioned. Therefore concerning taphonomy, it is obvious that after the dolphin death, the floating carcass decayed and the bones spread apart. For a time, this bone was carried by currents and perhaps, rolled by waves (some rolling marks can be noticed, mainly on the proximal part), after definitively buried.

CONCLUSIONS

This is the first report of a small dolphin assigned to Kentriodontidae in the Early Sarmatian of Suceava District. This find is an additional evidence of the presence of Kentriodontids in eastern Romania. In our country, the dolphin fossils predominantly occurred in the Sarmatian deposits, mainly in Volhynian. They are seemingly missing in the Badenian fossil record, as well after the Sarmatian. Such a stratigraphic distribution has to be explained by a trophic and palaeogeographical control on this group of marine mammals. The Volhynian palaeogeography of Romania illustrates an archipelago sketched on the Carpathian belt, with rather numerous passage ways between on the one hand in the Pannonian and Transylvanian basins, and the other in the areas located eastern to the Carpathians in Moldova (RÖGL, 1999), allowing a uniform regional distribution of the cetaceans. This situation changed after the Sarmatian mainly due to the Moldavian tectogenesis, a Volhynian event (BĂNCILĂ, 1958).

The origin of Kentriodontids in Paratethys still needs additional finds and any new discovery completing this topic will be of main interest.

ACKNOWLEDGEMENTS

Authors thank Dr. Márton Venczel (Țării Crișurilor Museum Oradea) for the photograph of the dolphin ulna from Tășad illustrated in Fig. 4c and Ph.D. candidate Alexandru Solomon (Babeș-Bolyai University Cluj-Napoca) for his help in processing Fig. 4 on computer.

REFERENCES

- BĂNCILĂ I. 1958. *Geologia Carpaților Orientali*. Edit. Științifică. București. 367 pp.
- BRÂNZILĂ M., MACALEȚ R., COSTEA, C. 1992. Contribution à l'étude du Volhynien dans la zone Arghira (Plateforme Moldave). *Analele Științifice ale Universității „Al. I. Cuza”*. Iași. **38-39**: 137-156.
- CODREA V. 1996. Données nouvelles concernant les Cétacés du Sarmatien de Cluj-Napoca. *Studii și cercetări. Muzeul Județean Bistrița*. **1**: 91-97.
- CODREA V. 2006. Neogene baleen whales (Cetacea: Mysticeti) from Transylvania and Oltenia. *Studii și cercetări. Geology-Geography. Muzeul Județean Bistrița*. **11**: 9-16.
- CODREA V. 2008. A fossil-bearing “Feleacu concretion” in Vâlcele (Cluj district). *Studii și cercetări. Geology-Geography. Muzeul Județean Bistrița*. **13**: 19-22.
- CODREA, V. & SEREȚEAN V. 2004. A Middle Miocene dolphin from Domașnea (Caransebeș-Mehadia Miocene Basin). *Studia Universitatis Babeș-Bolyai. Geologia*. Cluj-Napoca. **49**(2): 3-10.
- GRASU C., MICLĂUȘ C., BRÂNZILĂ M., BOBOȘ I. 2002. *Sarmatianul din sistemul bazinelor de foreland ale Carpaților Orientali*. Edit. Tehnică. București. 407 pp.
- IAMANDEI S., IAMANDEI E., IONESI, V. 2008. New petrified Woods within Sarmatian Șomuz Formation, NE Romania. *Acta Palaeontologica Romaniae*. Iași. **6**: 137-144.

- IONESI B. 1968. *Stratigrafia depozitelor miocene de platformă dintre valea Siretului și valea Moldovei*. Edit. Academiei R. S. R. București. 396 pp.
- IONESI B. & GALAN V. 1988. Contributions à la connaissance des Cétacés fossiles du Sarmatien de la Plate-forme Moldave. *Analele științifice ale Universității „Al. I. Cuza” Iași*. Seria II b. Geologie-Geografie. Iași. **34**: 31-33.
- IONESI L. 1994. *Geologia unităților de Platformă și a Orogenului Nord-Dobrogean*. Edit. Tehnică. București. 280 pp.
- IONESI L., IONESI B., LUNGU A., ROSCA V., IONESI V. 2005. *Sarmațianul mediu și superior de pe Platforma Moldovenească*. Edit. Academiei Române. București. 558 pp.
- IONESI V., 2006. *Sarmațianul dintre Valea Siretului și Valea Șomuzului Mare*. Edit. Universității „Al. I. Cuza” Iași. 238 pp.
- KAZÁR E. & VENCZEL M. 2003. Kentriodontid remains (Cetacea: Odontoceti) from the Middle Miocene of Bihor County, Romania. *Nymphaea: folia folia naturae bihariae*. Muzeul Țării Crișurilor. Oradea. **30**: 39-66.
- KAZÁR E., VREMIR M., CODREA, V. 2004. Dolphin remains (Cetacea: Odontoceti) from the Middle Miocene of Cluj-Napoca, Romania. *Acta Paleontologica Romaniae* (Eds.: V. A. Codrea, I. Petrescu, P. Dica). Cluj-Napoca **4**: 179-189.
- KAZÁR E. & GRIGORESCU D. 2005. Revision of *Sarmatodelphis moldavicus* Kirpichnikov, 1954 (Cetacea: Delphinoidea), from the Miocene of Kishinev, Republic of Moldavia. *Journal of Vertebrate Paleontology*. Chicago. **25**(4): 929-935.
- KIRPICHNIKOV A. A. 1954. Two new dolphin genera from the Sarmatian of the USSR. *Akademiya Nauki SSSR. Trudii Paleontologiceskogo Instituta*. Moskwa. **47**: 181-193 [in Russian].
- KOCH A. 1899. Egy kihalt czetfélének farkcsigolya-maradványai Koloszárról. *Földtani Közlöny*. Budapest. **29**: 148-153.
- KUDRIN L. N. & TATARINOV K. A. 1965. O miotsenovykh del'finakh Zapadnoy Ukrainy. *Paleontologicheskii Zhurnal*. Moskwa. **4**: 68-74 [in Russian].
- MACAROVICI N. 1964. Contributions à la connaissance du Sarmatien entre la vallée du Siret et les Subcarpathes. *Analele Științifice ale Universității „Al. I. Cuza”*. Iași. **10**: 13-43.
- MACAROVICI N. & OESCU C. V. 1942. Quelques vertébrés fossiles trouvés dans les calcaires récifales de Chișinău (Bessarabie). *Analele Academiei Române. Memoriile Secțiunii Științifice*. București. **27**: 351-382.
- MACAROVICI N. & ZAHARIA N. 1968. Asupra unor mamifere fosile din Sarmațianul Podișului Moldovenesc. *Buletinul Societății de Științe Geologice din R. S. România*. București. **5**: 217-227.
- NICOLAESCU V. 1933. Cetacee neogene din România. *Buletinul Societății Studenților în Științe Naturale*. (1932). București. **3**: 85-88.
- PILLER W. & HARZHAUSER M. 2005. The myth of the brackish Sarmatian Sea. *Terra Nova*. Blackwell Publishing Ltd US. New Jersey. **5**: 450-455.
- RÖGL F. 1999. *Circum-Mediterranean Miocene Paleogeography*. In: The Miocene Land Mammals of Europe (G. E. Rössner & K. Keissig, eds.). Verlag Dr. Friedrich Pfeil. München: 39-48.
- SIMIONESCU I. 1931. Mamifere marine din Sarmaticul dela Balcic. *Memoriile Secțiunii Științifice*. Academia Română. Seria III. București. **8**(2): 147-157.
- SIMIONESCU I. 1943. Mammifères marins du sarmatien de Balcic (Roumanie). *Bulletin de la Séction Scientifique*. Académie Roumaine. București. **25**: 40-43.

Vlad A. Codrea

“Babeș-Bolyai” University Cluj-Napoca, Faculty of Biology and Geology,
Department of Geology, 1, Kogălniceanu Str., 400084 Cluj-Napoca, Romania.
E-mail : vlad.codrea@ubbcluj.ro

Rățoi Bogdan; Hiru Alexandru

“Alexandru Ioan Cuza” University of Iași, Faculty of Geology-Geography,
Department of Geology, 20 Carol I Blvd., RO-700505, Iași, Romania.
E-mail: bog21rat@yahoo.com; hiru_alex@yahoo.com

Laurențiu Ursachi

“Vasile Pârvan” Museum Bârlad, Natural Sciences Branch,
54, Alexandru Vlahuță Str.; Bârlad, Romania.
E-mail: ursachi_laur@yahoo.com

Received: March 24, 2014

Accepted: June 19, 2014