NEW REPORT OF CETOTHERIID (CETACEA: MYSTICETI) REMAINS FROM SOUTHWESTERN ROMANIA

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Abstract. The Miocene deposits of the Carpathian Foreland yielded marine vertebrate remains in numerous fossil localities. Various authors have described a fauna composed of pinnipeds, sea birds, turtles, bony fish, and cetaceans. This fauna is characteristic to the Paratethys epicontinental sea. The family Cetotheriidae appears to have included most baleen whale taxa that lived in the Eastern Paratethys in general, and in the Dacian Basin in particular, during the Miocene. In the Dacian Basin, several Miocene cetotheriid occurrences have been mentioned so far, yet remain scarce. The aim of this work is to describe previously unpublished cetotheriid remains housed at the Museum of Oltenia Craiova and to provide an updated distribution of the cetotheriid fossil localities from the Dacian Basin.

Keywords: Neogene, Dacian Basin, Cetotheriidae, Romania.

Rezumat. Noi semnalări de cetotheriide (Cetacea: Mysticeti) din sud-vestul României. Depozitele miocene ale Forelandului Carpatic au furnizat resturi de vertebrate marine în numeroase localități fosilifere. Diverși autori au descris o faună formată din pinipede, păsări marine, țestoase, pești osoși, și cetacee. Această faună era caracteristică pentru marea epicontinentală numită Paratethys. Familia Cetotheriidae pare că a inclus majoritatea taxonilor de balene cu fanoane care au trăit în Paratethys-ul Estic în general și în Bazinul Dacic în particular, în timpul Miocenului. În Bazinul Dacic au fost menționate doar câteva localități fosilifere care au furnizat resturi fosile de cetotheriide miocene, însă aceste semnalări rămân rare. Scopul acestei lucrări este de a descrie unele resturi fosile de cetotheriide găzduite în Muzeul Olteniei Craiova și nepublicate anterior, dar și de a furniza o distribuție actualizată a localităților din Bazinul Dacic de unde se cunosc resturi fosile de cetotheriide.

Cuvinte cheie: Neogen, Bazinul Dacic, Cetotheriidae, România.

INTRODUCTION

Marine vertebrate remains are abundant finds in the Miocene deposits of the Carpathian Foreland. Various phocid remains found in the fossiliferous limestones near the city of Chișinău (Moldavian Platform), currently the Republic of Moldova, were studied, culminating with the description of a new seal species, *Phoca bessarabica* Simionescu, 1925. From the same deposits, SIMIONESCU (1942) described a skull, and assigned it to the genus *Cyrtodelphis* Dal Piaz, 1916. KAZÁR & GRIGORESCU (2006) reassign this specimen to *Sarmatodelphis moldavicus* (Kirpichnikov, 1954). Additional pinniped and cetacean remains from the same unit were mentioned from Ghireni, Ringhilești, Ciurea, Cordăreni, Stâncești, Săveni, Darabani, Mitoc, Voinești, Stăuceni, Leucușești, Erbiceni, Românești, and Aroneanu by subsequent papers (MACAROVICI & OESCU, 1941; MACAROVICI, 1942; 1944; MACAROVICI & ZAHARIA, 1968; IONESI & GALAN, 1988; CODREA et al., 2014; GOL'DIN et al., 2020). Other Miocene marine mammal remains were reported from the Moesian Platform. In the Dobrogean Sector of the platform (see SĂNDULESCU, 1984 for the structural setting of the Moesian Platform), several sites (Plopeni, Cotu Văii, Urluia, Adamclisi, Coroana, and Șipotele) yielded scarce marine vertebrate remains (SIMIONESCU, 1931; CHIRIAC & GRIGORESCU, 1975; GRIGORESCU, 1976; GRIGORESCU et al., 1986; SAINT-MARTIN et al., 2013). More noteworthy are the sites of Credința and Ciobănița where a fauna comprising pinnipeds, cetaceans, marine birds, bony fishes, and chelonians was found and described (CHIRIAC & GRIGORESCU, 1975; GRIGORESCU, 1976; GRIGORESCU & KESSLER, 1976; GRIGORESCU et al., 1986; GAL & KESSLER, 2005; GRIGORESCU, 2018). SIMIONESCU (1931) described various cetacean remains from Balcic, in the Varna Basin, corresponding to the eastern part of the Wallachian Sector of the Moesian Platform. The Dacian Basin, covering most of the Wallachian Sector of the Moesian Platform, contains Neogene marine sediments, which makes it an area of interest for the study of marine vertebrates. However, the studies published on the topic of marine vertebrates are scarce, and only several mysticete occurrences are mentioned: Orșova, Mădulari, Voitești, Oteșani, Glodeni, and Gornicel-Vâjoaia (NICOLAESCU, 1933; CODREA, 2006). The aim of this paper is to describe previously unreported cetacean fossil remains found in the Dacian Basin, currently housed by the Museum of Oltenia Craiova, and to provide an update on the palaeogeographical distribution of the Middle Miocene cetaceans in the Dacian Basin.

MATERIAL AND METHODS

The studied material is represented by 37 cetothere fossil remains housed in the collections of the Museum of Oltenia Craiova. The specimens were stored at the museum, being collected by unknown persons, from Mogoșani, Ohaba, Roești, and Bobu (Gorj and Vâlcea counties), as indicated on their accompanying labels. Since no Miocene deposits were reported near the locality of Roești (CODARCEA et al., 1968), a simplified geological map of the remaining three localities will be provided. The specimens are represented by postcranial remains in various stages of

preservation, namely, 14 lumbar vertebrae, 21 caudal vertebrae, and one proximal humeral fragment. Due to the poor preservation of some specimens, as well as the high number of specimens from the same region of the vertebral column, only the more complete vertebrae are illustrated. The specimens were taxonomically identified based on comparisons to similar specimens from published literature. Systematic nomenclature follows GOL'DIN et al. (2014) and GOL'DIN & STARTSEV (2017). Macrophotographs were taken using a Canon EOS 4000D camera with a Canon EF-S 18-55 mm lens. Measurements of the specimens follow GOL'DIN et al. (2014) and were taken using a digital calliper for specimens under 150 mm and with a measuring tape for specimens over 150 mm. Abbreviations: CL = centrum length; CW = centrum width; CH = centrum height; TH = total height; TW = total width.

GEOLOGICAL SETTING

The fossil remains described herein were found in several fossil localities in the Gorj and Vâlcea counties (see above, Material and Methods). The specimens were not accompanied by information regarding the lithology of the containing deposits. To understand the general framework of the geological setting of the area in which the specimens discussed herein were found, a brief lithological and stratigraphical description of the Middle Miocene deposits of the Dacian Basin will be provided below.

The Sarmatian deposits of the Dacian Basin belong to the Upper Badenian–Quaternary sedimentary cycle (Fig. 1), as defined by IONESI (1994).

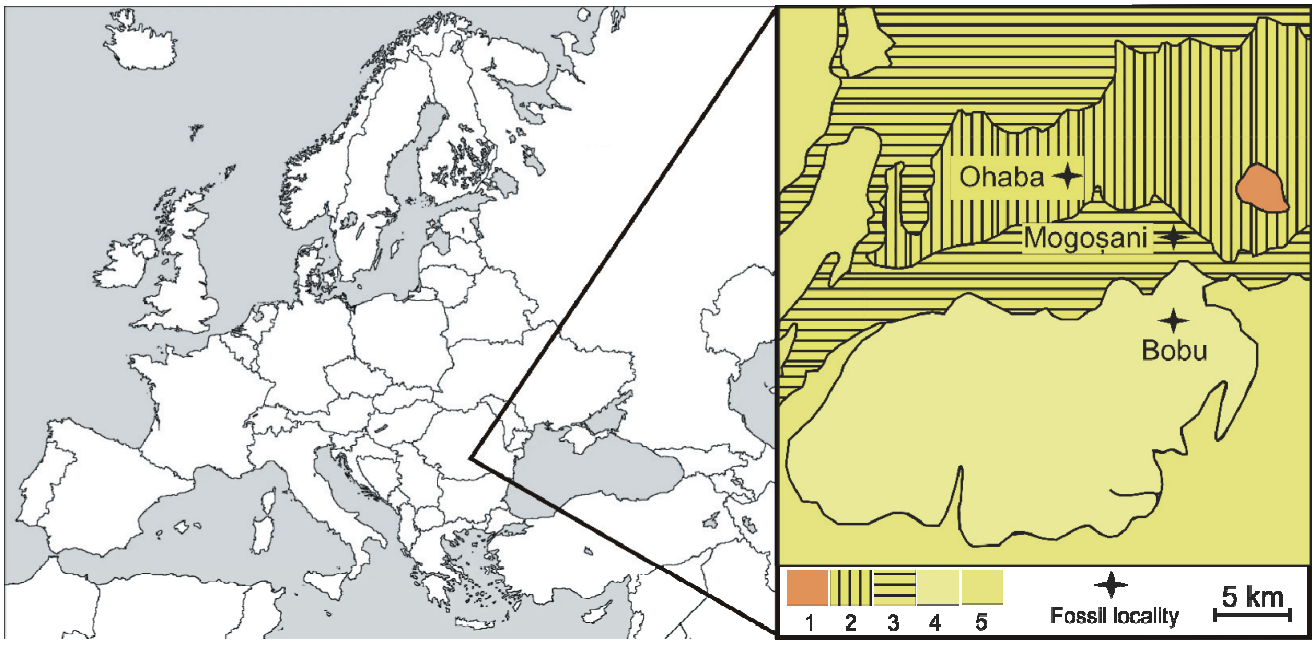

Figure 1. Location of the fossil sites in southwestern Romania (left) and a simplified geological map of the area where the fossil specimens were found (right). General geological map modified after CODARCEA et al., 1968. 1. Paleogene; 2. Volhynian–Bessarabian; 3. Bessarabian–Maeotian; 4. Pliocene; 5. Quaternary.

The Sarmatian deposits are mostly represented by clays, silts, and sands interspersed with sandstones, oolitic limestones, and biosparites. The faunal assemblage of these deposits (that was found in boreholes) included gastropods, bivalves, ostracods, and foraminifera that attest to the presence of all three substages of the Sarmatian. The Volhynian deposits transgressively overlie a Badenian or Cretaceous substrate, and are lithologically heterogeneous, clastic rocks (sands, clays, silts, sandstones) being predominant. The sedimentary sequence continues with Bessarabian deposits. Lithologically, these deposits are composed of clays and silts, accumulated in deeper environments, while the limestone, sandstone, and sandy deposits were accumulated in shallower environments. The Khersonian deposits are composed of sands, silts, marls, and biosparites. The latter overlay either Volhynian or Bessarabian deposits. PAULIUC et al. (1979) mentions the absence of Khersonian deposits in the area situated between the Olt and Dâmbovița rivers, whereas IONESI (1994) mentions their presence in the north-eastern part of the Dacian Basin. The restricted area of these deposits, as well as the impossibility of radical faunal change under continuous sedimentation conditions, might attest to a sedimentary hiatus between the Bessarabian and Khersonian.

SYSTEMATIC PALAEONTOLOGY

Class Mammalia Linnaeus, 1758
Order Cetacea Brisson, 1762
Suborder Mysticeti Cope, 1891
Family Cetotheriidae Brandt, 1872
Cetotheriidae indet.

In case of the lumbar vertebrae (7292, 12785, 12787, 12788, 12790, 12791, 12794, 12930.2, 12930.3, 12930.7, 30001, 30002, 30104, 30107 – Fig. 2), no specimen is complete; however, some vertebrae do retain the bases of the transverse processes, which show a postero-ventral orientation. All specimens show distinct signs of river transportation, suggesting that they were found in the alluvial deposits of the various rivers of the region. Due to this fact, most anatomical characters are lost. The centra are smoothened by water transport, and all their processes were broken, most likely also due to river transportation. All vertebrae also appear flattened dorsoventrally, similar to lumbar vertebrae of *Cetotherium riabinini* Hofstein 1948 (GOL'DIN et al., 2014). All specimens lack the neural arch, so no information regarding the neural canal can be provided. In dorsal or ventral views no foramina can be observed on the surface of the centra or at the bases of the transverse processes. In ventral view, all specimens present two relatively shallow, but wide grooves that show where the lateral arteries were located. These vertebrae are distinct from the caudal ones by the lack of the processes for the articulation of the haemal arch. The specimens are distinct by their very large size and pachyosteosclerosis, a characteristic trait of cetotheriids from the Eastern Paratethys (GOL'DIN & STARTSEV, 2017). These vertebrae differ from those of kentriodontid taxa by the presence of the pachyosteosclerosis, large size, more massive centra (whereas the centra of kentriodontid lumbar vertebrae are more elongated). These specimens were assigned to the family Cetotheriidae based on the characters mentioned above. Measurements for these vertebrae are presented in Table 1.

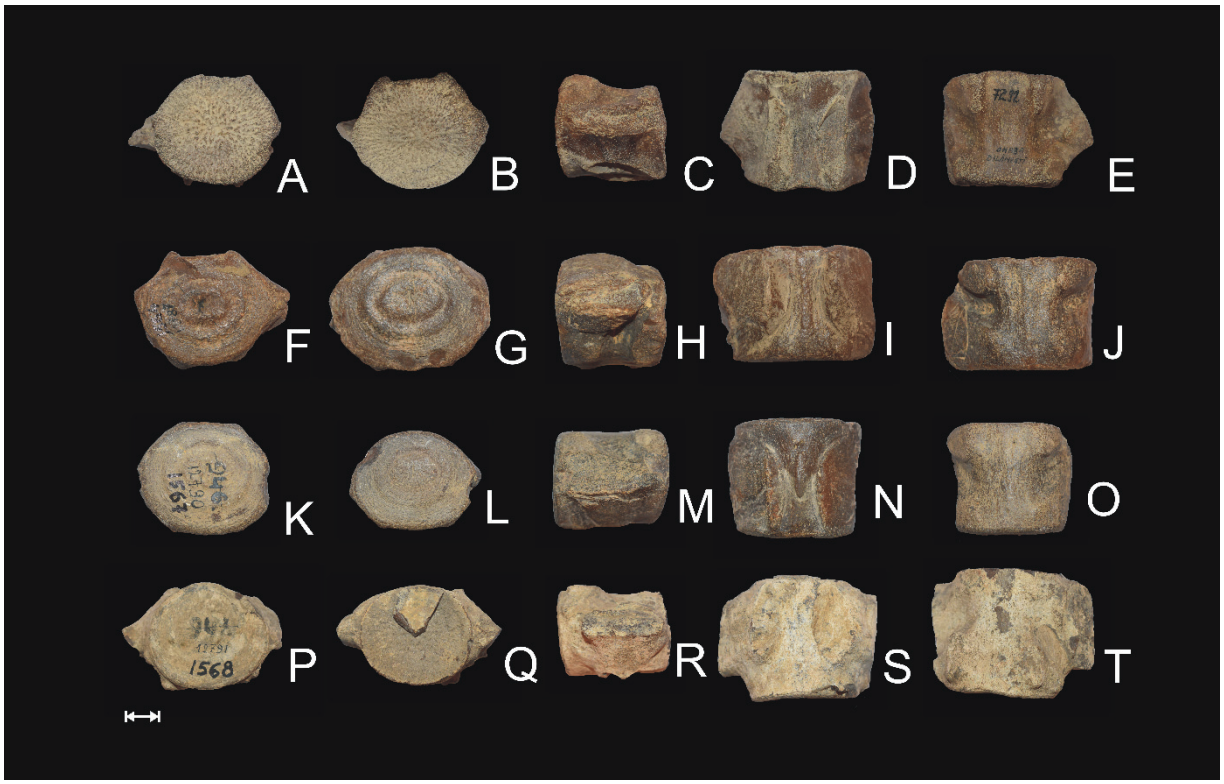

Figure 2. Cetotheriid lumbar vertebrae: 7292 in: A. cranial view; B. caudal view; C. lateral view; D. dorsal view; E. ventral view. 12787 in: F. cranial view; G. caudal view; H. lateral view; I. dorsal view; J. ventral view. 12970 in: K. cranial view; L. caudal view; M. lateral view; N. dorsal view; O. ventral view. 12791 in: P. cranial view; Q. caudal view; R. lateral view; S. dorsal view; T. ventral view. Scale bar: 10 mm.

In the case of the caudal vertebrae (1707, 12773, 12786, 12789, 12792, 12795, 12796, 12797, 12793, 12930, 12930.1, 12930.4, 12930.5, 12930.6, 12930.8, 12931, 30099, 30102, 30103, 30105, 30106 – Fig. 3), various stages of preservation also occur. These vertebrae are more complete than the lumbar ones, yet they also show signs of river transportation, but the effect is not as noticeable here, as more of their processes are intact. Specimens 1707, 12773, 12786, 12793, 12796, 12930.5, 12930, 30099, 30102, 30103, 30105, 30106 present short, but high centra. The

morphology of the neural arch is as follows: vertebrae from the anterior part of the vertebral column have a more developed arch, with a slightly wider neural canal, whereas vertebrae from the posterior part (at least up to the 11th caudal) have a less developed neural arch, with a narrower neural canal. These specimens do no present transverse processes, and the overall morphology suggests an anatomic position situated in the anterior part of the caudal segment of the vertebral column.

Figure 3. Cetotheriid caudal vertebrae: 30102 in: A. cranial view; B. caudal view; C. lateral view; D. dorsal view; E. ventral view. 30105 in: F. cranial view; G. caudal view; H. lateral view; I. dorsal view; J. ventral view. 30106 in: K. cranial view; L. caudal view; M. lateral view; N. dorsal view; O. ventral view. Scale bar: 10 mm.

The remaining vertebrae (12789, 12792, 12795, 12797, 12930.1, 12930.5, 12930.6, 12930.8, 12931) have a slightly different morphology, with a flattened centrum, not as high as the specimens mentioned above. The transverse processes were present, however only their bases are preserved, and they present small foramina that cross the entire bases of the processes, observable both from ventral and dorsal views. This differs from caudal the caudal vertebrae of species such as *Cetotherium riabinini* that present no such foramina on any of the caudal vertebrae (GOL'DIN et al., 2014). In ventral view, one can observe the pairs of processes for the articulation of the haemal arch. These vertebrae are assigned to an unidentified member of the family Cetotheriidae based on their large size and pachyosteosclerosis, a defining trait shared only by members of this family in the late Middle Miocene (GOL'DIN et al., 2020). Measurements for these vertebrae are presented in Table 1.

Lastly, specimen 12930.9 (Fig. 4) is a *caput humeri*. The specimen is poorly preserved. Signs of hydrodynamic transport are present on the specimen, with the proximal part being smoothed. Still, some characters are present on this fragment. The humeral head is round and massive. The greater tubercle is very well developed and situated above the humeral head. Situated next to it is the lesser tubercle, which seems less developed than the greater tubercle. The greater tubercle positioned above the humeral head is a character also seen in *Mithridatocetus* Gol'din & Startsev, 2016 (GOL'DIN & STARTSEV, 2016). The better developed greater tubercle in comparison to the lesser one is also a characteristic of the above-mentioned genus, but due to poor preservation it is difficult to say whether the relative difference in size of the two tuberculi is due to water erosion or not. A humerus described by TORCĂRESCU (2023) and assigned to *Mithridatocetus* sp. also shares these characteristics, but that specimen is complete and the difference in the development of the two tubercles is very striking. The two tubercles of specimen 12930.9 might both have been well developed, however due to the poor preservation of the specimen their development is hard to determine. The similarly well-developed tubercles are a characteristic of both *Cetotherium riabinini* and *Ciuciulea davidi* Gol'din, 2018 (GOL'DIN et al., 2014; GOL'DIN, 2018). Unfortunately, the specimen is poorly preserved and incomplete, and other features, such as the development of the deltoid crest, are missing. As such, the studied specimen from the Museum of Oltenia Craiova collection will be assigned to an unidentified member of the family Cetotheriidae. The proximal part of the humerus is 87 mm wide, whereas the caput humeri is 70 mm wide.

Table 1. Cetotheriid vertebrae measurements in mm.

Inv. No.	Locality	CL	CW	CH	TL	TH	Type
7292	Ohaba, Gorj County	66.23	71.51	61.48	63.23	91.95	lumbar vertebra
12785	no locality given	75.69	81.33	73.34	89.25	106.96	lumbar vertebra
12787	no locality given	67.26	85.73	68.29	72.72	95.43	lumbar vertebra
12788	no locality given	70.71	71.72	75.91	74.67	95.2	lumbar vertebra
12790	no locality given	69.55	82.7	64.08	61.86	79.17	lumbar vertebra
12791	no locality given	69.95	66.52	60.64	51.93	98.47	lumbar vertebra
12794	no locality given	59.74	68.77	54.23	47.63	70.35	lumbar vertebra
12930.3	Mogoșani, Gorj County	51.53	76.18	58.26	60.83	96.38	lumbar vertebra
12930.7	Mogoșani, Gorj County	56.35	68.26	55.38	67.58	92.27	lumbar vertebra
30100	Bobu, Gorj County	50.03	72.01	54.31	55.43	79.74	lumbar vertebra
30101	no locality given	69.3	69.71	67.55	68.24	85.47	lumbar vertebra
30104	Bobu, Gorj County	67.15	71.61	58.72	58.9	92.85	lumbar vertebra
30107	Bobu, Gorj County	65.77	73.66	74.81	80.48	94.06	lumbar vertebra
1707	Mogoșani, Gorj County	41.06	65.33	47.02	47.68	83.4	caudal vertebra
12773	no locality given	78.36	63.92	67.71	86.02	72.38	caudal vertebra
12786	no locality given	69.29	79.04	72.41	102.9	95.05	caudal vertebra
12789	no locality given	64.01	78.18	68.42	67.17	90.48	caudal vertebra
12792	no locality given	65.56	57.42	63.31	58.72	73.27	caudal vertebra
12973	no locality given	48.76	55.68	63.78	83.7	67.93	caudal vertebra
12795	Roești, Vâlcea County	51.63	57.23	64.8	71.38	58.2	caudal vertebra
12796	no locality given	56.28	53.81	62.61	71.12	62.72	caudal vertebra
12797	Roești, Vâlcea County	60.7	52.8	62.23	69.08	57.75	caudal vertebra
12930	Mogoșani, Gorj County	70.89	66.9	59.79	75.26	80.66	caudal vertebra
12930.1	Mogoșani, Gorj County	58.15	66.9	72.22	90.89	65.02	caudal vertebra
12930.4	Mogoșani, Gorj County	70.67	75.83	67.14	68.9	87.98	caudal vertebra
12930.5	Mogoșani, Gorj County	62.27	58.3	34.98	79.21	76.25	caudal vertebra
12930.6	Mogoșani, Gorj County	80.6	37.72	63.11	73.07	50.2	caudal vertebra
12930.8	Mogoșani, Gorj County	59.43	40	67.48	68.15	59.01	caudal vertebra
12931	Mogoșani, Gorj County	80.01	91.42	81.37	95.04	124.57	caudal vertebra
30099	Bobu, Gorj County	57.22	71.44	64.81	101.46	98	caudal vertebra
30102	no locality given	76	77.4	70.73	95.65	77.24	caudal vertebra
30103	no locality given	63.24	63.1	65.56	72.48	62.55	caudal vertebra
30105	no locality given	60.55	64.31	65.52	93.05	72.16	caudal vertebra
30106	no locality given	69.6	67.02	71.44	96.87	79.46	caudal vertebra

Figure 4. Cetotheriid caput humeri 12930.9 in: A. lateral view; B. ventral view. Scale bar: 10 mm.

DISCUSSIONS

Paratethyan Cetotheriidae included, at one point, nine nominal species, assigned to the genus *Cetotherium*. However, new studies helped achieve a better understanding on the systematics of the family which presently, includes seven species belonging to five genera: the genus *Cetotherium* includes the species *C. rathkii* Brandt, 1843 and *C. riabinini*, the genus *Brandtocetus* that includes the species *B. chongulek* Goldin & Startsev 2014, the genus *Kurdalagonus*, that includes the species *K. mchedlidzei* Tarasenko & Lopatin, 2012, the genus *Mithridatocetus*, that includes the species *M. eichwaldi* Gol'din & Startsev, 2016 and *M. adygeicus* Tarasenko & Lopatin, 2012, and the genus *Zygiocetus*, that includes the species *Z. nartorum* Tarasenko, 2014 (GOL'DIN & STARTSEV 2016). Before this taxonomic reassessment, the genus *Cetotherium* was used as a wastebasket taxon, where cetotheriid fossils were included with little regard to their systematic relationship. Of those nine nominal species, several, such as *Cetotherium priscum*, were relegated to the status of *nomen dubium*, due to either the lack of diagnostic characters of the type material, or due to the loss of the type material altogether.

In terms of distribution, cetotheriid fossils were found all over the world. Inside of the Paratethys realm, fossils were reported from Romania (NICOLAESCU, 1993; CODREA, 2006), Austria (PIA & SICKENBERG, 1934), Bosnia and Herzegovina (STEFANOVIĆ, 2010), Republic of Moldova (MACAROVICI & OESCU, 1941; GOL'DIN, 2018), Ukraine (GOL'DIN et al., 2014; GOL'DIN & STARTSEV, 2014, 2016), Georgia (MCHEDLIDZE, 1988), and the Russian Federation (SPASSKI, 1951; PILLERI, 1986).

CONCLUSIONS

The studied material is composed exclusively of postcranial remains, of which the vertebrae are the most abundant. A number of 35 vertebrae and one proximal humerus fragment from various sites in the Dacian Basin were studied in this manuscript and assigned to indeterminate taxa of the family Cetotheriidae. Unfortunately, these remains show distinct signs of hydrodynamic transport. Their centra are smoothened by water transport, incomplete, and all their apophyses are broken. Likewise, the proximal humerus fragment is also very eroded, losing some characteristics that might provide insight regarding to the precise taxonomical attribution. There are several issues with cetacean material from this part of the Dacian Basin, issues also emphasized by CODREA (2006). Firstly, there is a distinct lack of diagnostic material. The vertebrae are not diagnosed to a very precise taxonomical level (FORDYCE & DE MUIZON, 2001), and the material here is no exception. While isolated remains may, in some instances, be important, (the humerus described by TORCĂRESCU, 2023 being one example), the lack of diagnostic elements and that of material in anatomical connection limit our understanding of the physical characteristics, the adaptations, behaviours, and taxonomical relationships that cetaceans from the Dacian Basin might have had with other cetaceans from the Paratethys. Secondly, there is limited information regarding the sedimentary deposits in which these remains were found. Most specimens were found in recent river alluvia, removed from their original stratigraphic context. Further studies are needed in order to identify the sedimentary layers that yielded the cetacean fossil remains presented in this paper.

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