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CETOTHERIIDAE (CETACEA, MYSTICETI) FROM THE COLLECTIONS OF THE NATIONAL GEOLOGICAL MUSEUM, BUCHAREST (ROMANIA)

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Cetotheriidae (Cetacea, Mysticeti) from the Collections of the National Geological Museum, Bucharest (Romania). Torcărescu, B.-A. — Cetacean fossil remains attributed to Cetotheriidae are certainly not a novelty in the fossil record of the Carpathian Foreland or Foredeep, several sites being mentioned; however there remains much material in institutional collections that can still add to the number of fossiliferous localities where cetotheriids can be found. The aim of this paper is to bring to attention new material from fossiliferous localities from the western Dacian Basin (Gorj and Vâlcea Counties), from the collections of the National Geological Museum. The specimens are described, identified based on comparisons with similar specimens from published literature and a discussion about the species *Cetotherium priscum* is provided.
Key words: Neogene, Cetaceans, Cetotheriidae, Dacian Basin, Romania.

Introduction

Institutional collections, when properly managed, have the potential to provide a treasure trove of information regarding the fossil specimens housed in them. On the other side, poor management of the collections can lead to loss of valuable geological information. Such is the case of the cetacean specimens mentioned in this article. They were donated to the National Geological Museum, however for several specimens no information about the locality of provenance, as well as more detailed information regarding where they were found, was

recorded. So, regarding the provenance of the material only the name of the localities can be given, a more precise location or the deposits in which they were found being unavailable.

The main aim of this paper is to bring to attention the cetothere fossil specimens housed in the collections of the National Geological Museum, to provide descriptions and discussions based on the material, to taxonomically identificate the material and to provide new cetotheriid fossiliferous localities that were not mentioned previously in published literature (from Gorj county, SW Romania). Cetotheriidae represents a widely distributed family of small to medium sized Neogene baleen whales which is believed to include most of the baleen whales from the Eastern Paratethys during the Middle and Late Miocene (Brandt, 1873; Simionescu, 1931 and references herein). Cetotheriidae remains are mentioned in scientific literature from the Eastern Paratethys of the present-day various regions in Romania: the Wallachian Sector of the Moesian Platform (Nicolaescu, 1933), the Dobrogean Sector of the Moesian Platform (Grigorescu, 2018), the northern part of the Moldavian Platform (Gol'din et al., 2020 and references herein), as well as from the Carpathian Foredeep (Paucă, 1940). Other sites from the Dacian and Transylvanian basins are mentioned by Codrea (2006), which describes Cetotheriidae like vertebrae; however the author assigns them to Mysticeti indet. However, the number of reports is very low, thus leading to a poor understanding and a poor study of this family of marine mammals in Romania.

Material and Methods

The studied material is represented by 15 cetothere fossil remains housed in the collections of the National Geological Museum in Bucharest, Romania. The specimens are represented by postcranial remains, specifically 14 vertebrae in various stages of preservation and one complete humerus. The specimens were taxonomically identified based on comparisons with similar specimens from published literature. 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 and were processed using Photoshop. Figures with the specimens in various views were made using Corel DRAW 12. Measurements of the specimens follow Gol'din et al. (2014) and were taken with a digital caliper for specimens under 150 mm and with a measuring tape for specimens over 150 mm. All measurements are in mm and can be consulted in table 1 and table 2 for vertebrae. Measurements for humerus are given in the description of the specimen.

MGN = Muzeul Geologic Național; CL = centrum length; CW = centrum width; |CH = centrum height; TH = total height; TW = total width; GL = greatest length; BD = breadth of the distal end; BP = breadth of the proximal end; SD = smallest width of the diaphysis.

Geological context

Because no information regarding the sedimentary deposits in which these specimens were found is given, an overview of the Sarmatian s. l. deposits of the western Dacian Basin will be provided, in order to give an idea of the structure of the sedimentary deposits of this area. The Dacian Basin is a former basin of the Paratethys sea, that is situated between the Southern Carpathias and the Eastern Carpathian bend to the north, to the present course of the Lower Danube River to the south (Jipa & Olariu, 2009). The evolution of the Dacian Basin took place during a time when the Paratethys was composed of distinct basins, with variable communication between them (Jipa & Olaru, 2009), this cycle of opening and closing of communication avenues between the basins having profound paleoenvironmental implications. The fossiliferous localities are Vălari, Stănești, Voitești (fig. 1) and Mădulari. Sarmatian s. l. deposits occupy the largest surface, compared with other stages of the Miocene, two types of deposits being encountered: detritic on the rim and mostly pelitic in the south, the Sarmatian s. l. deposits being separated in three sequences: Volhynian–Lower Bessarabian, Upper Besarabian–Maeotian and Upper Bessarabian–Khersonian (Bercia et al., 1968).

The sedimentary sequence starts with sandy marls that overlay the Badenian marls, sandy marls that are composed of, in their lower part, by interspersed lenses and layers of sand and pelliculated marls, the latter presenting in their upper part coarse sands and gravels, these deposits being present until the western part of Voitești village (Bercia et al., 1968). The paleontological content of these deposits is represented by invertebrate remains, in the lower part specimens of *Ervilia* Turton 1822, *Modiolus* Lamarck 1799 and *Hydrobia* Hartmann 1821 being present while in the upper part specimens of *Mactra fabreana* d'Orbigny 1844, *Trochus marginatus* Eichwald 1830, *Cerithium lignitarum* Eichwald 1830, *Cryptomactra pesanseris* Mayer-Eymar 1857 and *Cardium oliquobsoletum armavirensis* Kolesnikov 1929 being present (Popescu, 1955; Marinescu, 1969; Bercia et al., 1968). As such this deposit could be tentatively assigned as a Volhynian to Bessarabian sequence.

The next sedimentary sequence overlays the previous one and is composed of finely stratified marls, with interspersed deposits of pelliculated marls, sands, and sandy marls, generally similar to the one of the previous sequences, the difference being in the higher frequency of the interspersed pelliculated marls and ostracod

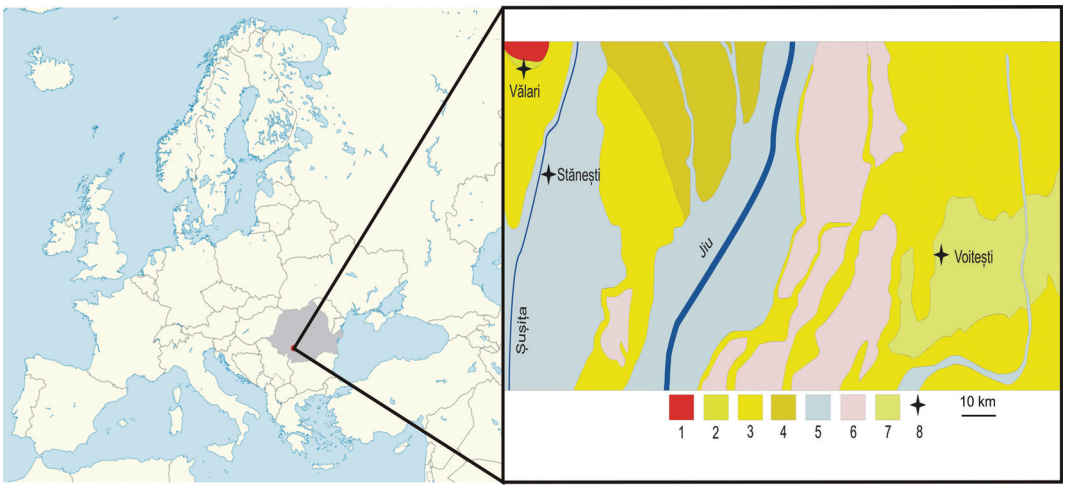

Fig. 1. Location of the studied area in Romania (left) and the geological structures and location of the fossiliferous localities (right) in Gorj County (modified after Codarcea et al., 1968): 1 — Igneous rocks; 2 — Sarmatian s. l.; 3 — Maeotian; 4 — Upper Besarabian–Maeotian; 5 — Holocene; 6 — Pleistocene; 7 — Volhynian–Lower Besarabian; 8 — fossiliferous locality

Holocene (Bercia et al., 1968). These deposits are situated in the Novaci depression and continue to the east and to the west, as well as south of the Ciocadia–Săcel anticline (Bercia et al., 1968). The paleontological content is also represented by invertebrate species such as: *Unio* cf. *subrecurvus* Teisseyre 1907, *Radix* cf. *velutina* Deshayes 1838, and *Congeria navicula* Andrusov 1897 (Popescu, 1955; Bercia et al., 1968).

The last sedimentary sequence, situated east of the Cerna River, on the northern rim of the Dacian Basin is composed of detritic deposits containing rare *Mactra* Linnaeus 1767 remains, characteristic of the Bessarabian and Khersonian, while eastwards, towards Râmnicu Vâlcea these detritic deposits overlay the Lower Bessarabian formations with *C. pesanseris*, and above these, the Maeotian deposits, predominantly detritic, composed of sands and sandy marls with gravel interlays follow (Bercia et al., 1968).

Systematic palaeontology

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

Caudal vertebrae (fig. 2)**:** The studied specimens represent caudal vertebrae, in various stages of preservation, only specimens MGN 10.067 and MGN 21117 are complete, the rest being fragmented. These specimens present a massive, short but high centrum. In dorsal view, one can observe the spinous process with a narrow neural canal. No transverse processes are preserved. The other vertebrae present a slightly different morphology, their centrum being flattened, but not high. They present lateral processes, more or less complete, and the spinous process is missing in all specimens. In dorsal view, small foramina can be observed on the surface of the vertebrae, located on each side of the centrum, at the bases of the transverse processes, which traverse it towards the ventral surface.

This is different from the caudal vertebrae of species such as *Cetotherium riabinini* Hofstein 1948, in which the caudal vertebrae do not have foramina at the bases of the transverse processes (Gol'din et al., 2014). On the ventral surface, one can observe the paired ventral processes for the articulation of the chevron bone. Comparing their morphology

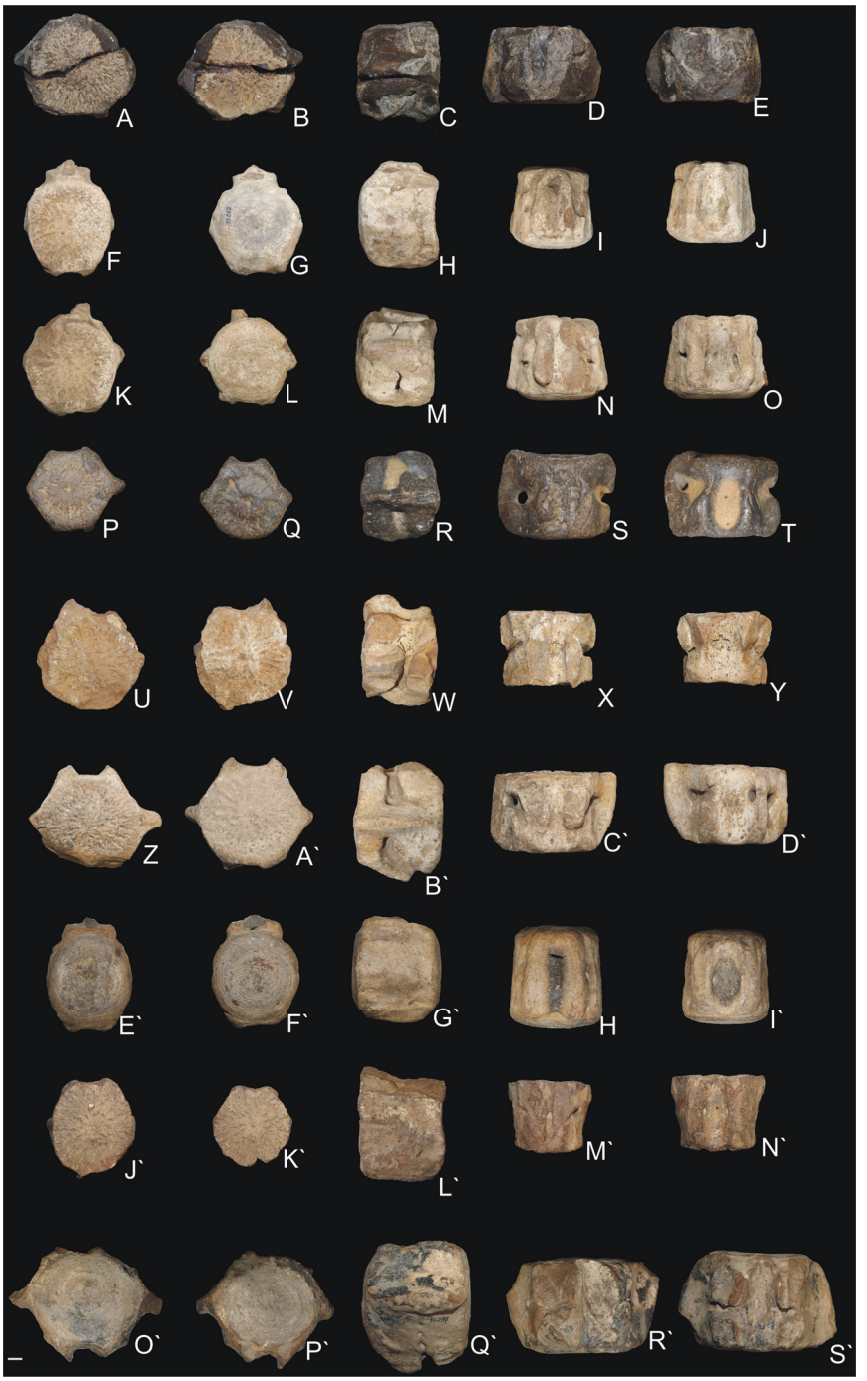

Fig. 2. Cetotheriidae caudal vertebrae: 10.096 in: A — cranial view; B — caudal view; C — lateral view. D — dorsal view; E — ventral view; 10.067 in: F — cranial view; G — caudal view; H — lateral view; I — dorsal view; J — ventral view; 10.143 in: K — cranial view; L — caudal view; M — lateral view; N — dorsal view; O — ventral view; 21.113 in: P — cranial view; Q — caudal view; R — lateral view; S — dorsal view; T — ventral view; 21.114 in: U — cranial view; V — caudal view; W — lateral view; X — dorsal view; Y — ventral view; 21.116 in: Z — cranial view; A` — caudal view; B` — lateral view; C` — dorsal view; D` — ventral view; 21.117 in: E` — cranial view; F` — caudal view; G` — lateral view; H` — dorsal view; I` — ventral view; 21.118 in: J` — cranial view; K` — caudal view. L` — lateral view; M` — dorsal view; N` — ventral view; 10.097 in: O` — cranial view; P` — caudal view; Q` — lateral view; R` — Dorsal view; S` — ventral view. Scale bar 10 mm.

Table 1. Cetotheriid lumbar vertebrae measurements in mm

Inv. no.	CL	CW	CH	TH	TW	Location
MGN 10.064	69.22	71.47	66.95	62.92	115.95	Mădulari, Vâlcea County
MGN 10.066	63.12	65.3	54.99	51.65	76.86	Mădulari, Vâlcea County
MGN 10.068	67.9	76.47	57.8	66.45	128.62	Vălari, Gorj County
MGN 10.069	60.31	60.33	56.77	58.03	79.95	Stănești, Gorj County
MGN 10.097	70.62	80.48	68.3	85.55	106.76	Voitești, Gorj County

Table 2. Cetotheriid caudal vertebrae measurements in mm

Inv. no.	CL	CW	CH	TH	TW	Location
MGN 10.067	51.68	55.52	59.66	73.83	57.87	Vălari, Gorj County
MGN 10.096	54.4	69.32	66.28	71.14	81.37	Voitești, Gorj County
MGN 10.143	53.93	59.86	59.26	74.66	69.56	Voitești, Gorj County
MGN 21.113	56.21	54.55	65.18	70.56	78.22	No location given
MGN 21.114	48.29	58.25	55.05	68.62	63.25	No location given
MGN 21.115	65.45	73.76	64.2	83.16	121.04	No location given
MGN 21.116	54.46	69.44	53.06	73.85	87.86	No location given
MGN 21.117	64.84	56.21	68.53	80.58	60.12	No location given
MGN 21.118	53.11	54.8	63.26	67.77	60.02	No location given

with other specimens (Gol'din et al., 2014; Gol'din & Startsev, 2017) we can assign studied specimens to the Cetotheriidae family based on its pachyosteosclerosis, a specific trait, a short but high centrum and reduced transverse processes, the absence of the neural arch from the 11th caudal vertebrae forward, as seen in species such as *C. riabinini* (Gol'din et al., 2014). Unfortunately, the lack of diagnostic morphological characters does not allow a more precise taxonomic assignment. The morphometric parameters of these vertebrae can be consulted in table 2.

Genus *Mithridatocetus* Gol'din & Startsev 2017
Mithridatocetus sp.

Lumbar vertebrae (fig. 3)**:** The studied specimens (MGN 10.064, MGN 10.066, MGN 10.068, MGN 10.069, MGN 10.097, MGN21115) present themselves in a poor state of preservation. The specimens are fragmented, worn down, only a few morphological characteristics being observable. They have massive, wide, slightly elongated centra. All specimens lack the spinous process. Some specimens show only one transverse process (MGN 10.064, MGN 10.066, MGN 10.069, MGN 21115) while MGN10.068 shows both transverse processes. In any case, none of the present processes is complete, their base being the ones that has been preserved the best. One can observe a slight postero-ventral orientation of the transverse processes, indicating that they are, indeed, lumbar vertebrae. In dorsal or ventral view no foramina can be observed on the surfaces of the centra. From a morphological point of view, the analyzed specimens are similar to vertebrae attributed to vertebrae attributed to *Mithridatocetus* sp. 1 sensu Gol'din & Startsev (2017), fig. 7 or *Cetotherium mayeri* Brandt 1871, and are distinct for their low height. The morphometric parameters of these vertebrae are presented in table 1.

Humerus (fig. 4)**:** The studied specimen (MGN 21112) represents a humerus, in a good state of preservation. It presents a massive diaphysis that ends towards the proximal

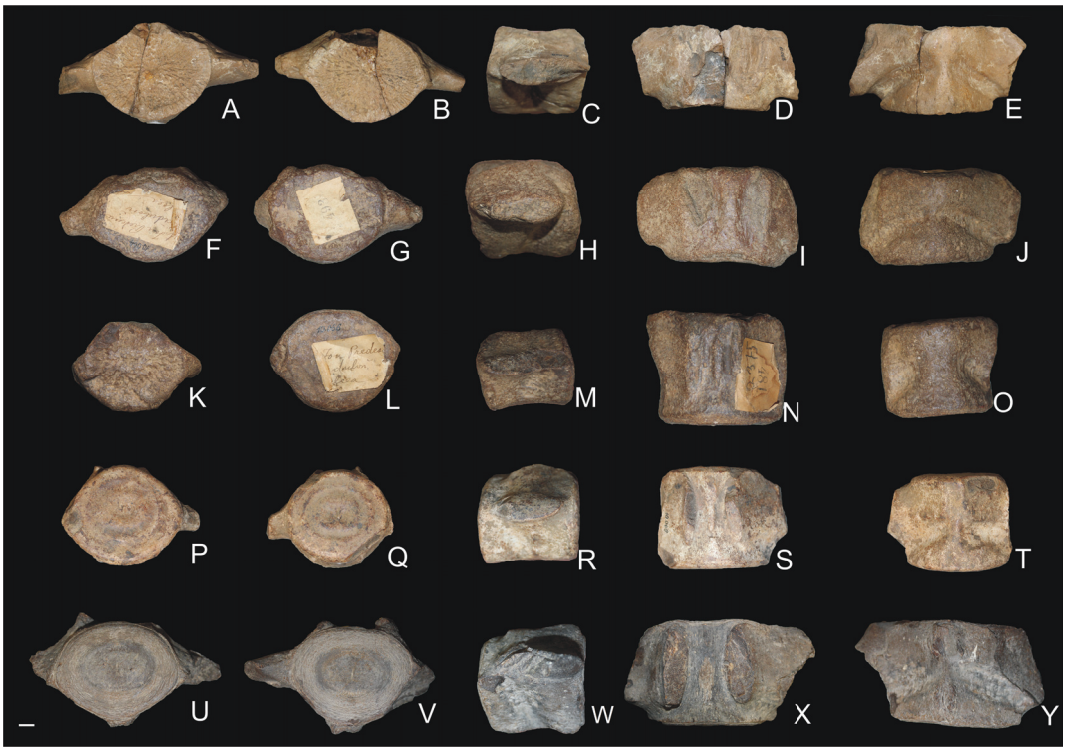

Fig. 3. Cetotheriidae lumbar vertebrae: 10.068 in: A — cranial view; B — caudal view; C — lateral view; D — dorsal view; E — ventral view; 10.064 in: F — cranial view; G — caudal view; H — lateral view; I — dorsal view; J — ventral view; 10.066 in: K — cranial view; L — caudal view; M — lateral view; N — dorsal view; O — ventral view; 10.069 in: P — cranial view; Q — caudal view; R — lateral view; S — dorsal view; T — ventral view; 21.115 in: U — cranial view; V — caudal view; W — lateral view; X — dorsal view; Y — ventral view. Scale bar 10 mm.

end with a very rounded, massive, humeral head. In dorsal view a slight flattening is observed. The proximal end is bigger than the distal end, an increase in size can be observed starting from the middle part of the diaphysis towards the proximal end, in dorsal view. Also in dorsal view, one can observe the greater tubercle, situated slightly elevated above the humeral head. The lesser tubercle is also present; however, it is reduced in comparison to the greater tubercle. The specimen also presents a low deltoid crest. The distal end of the specimen ends with the two articulation surfaces of the radius and ulna, both presenting

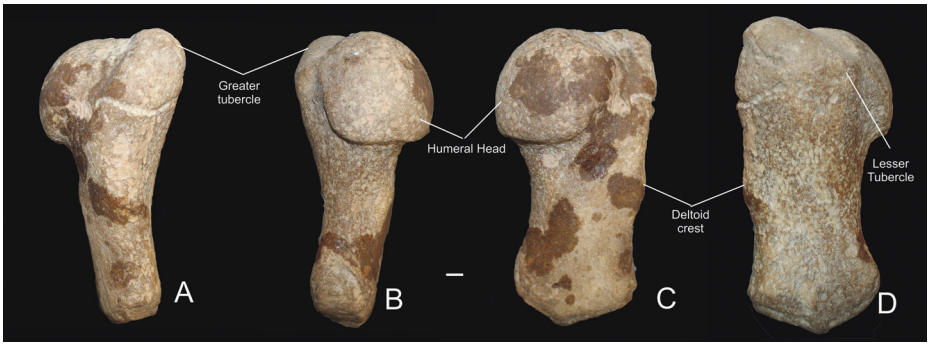

Fig. 4. Mithridatocetus sp. humerus 21.112 in: A — anterior view; B — posterior view; C — ventral view; D — dorsal view. Scale bar 10 mm.

a slight inclination from the lateral margin of the specimen toward the median part, thus giving the distal end a "V" shape, best observed in lateral view. Differs from *Cetotherium* by the fact that the humerus of *Cetotherium* present equally developed greater and lesser tubercles (Gol'din et al., 2014), unlike this specimen. The specimen morphologically resembles the humerus described by Brandt (1873) and Gol'din & Startsev (2017), as belonging to *Mithridatocetus* sp., as they both share a low deltoid crest, a greater tubercle situated above the humeral head and a lesser tubercle reduced in comparison to the greater tubercle, as such the studied specimen will be assigned to this taxon. Measurements: GL = 174 mm; BD = 87.53 mm; BP = 69.2 mm; SD = 58.21 mm.

Discussion

Cetotheriidae represent a family of baleen whales, that, after the revision of Bouetel & de Muizon (2006), was composed of six Neogene genera, however, after the description of new taxa, as well as the inclusion of the extant pygmy right whale (*Caperea marginata* Gray, 1846) into Cetotheriidae (Fordyce & Marx, 2013), the temporal distribution of this family is in constant flux (Gol'din & Startsev, 2017). The Eastern Paratethys was also one of the areas that saw Cetothere diversification, although not as strong as in the open ocean, diversification that followed the disappearance of baleen whales from the fossil record (Marx et al., 2019). The Eastern Paratethys is the area where the oldest and most basal species, *Ciuciulea davidi* Gol'din 2018, was described from (Gol'din, 2018). Two causes have been proposed for this disappearance: a shift in the quantity of δ18O (Zachos et al., 2008), as well as a drastic decrease (of 40 meters) of the eustatic level (Miller et al., 2005), the latter cause being important, given the fact that no cetacean species faced environmental pressure such as this (Marx et al., 2019). Baleen whales reappear in the fossil record during the Early-Middle Miocene, a reappearance that is associated with the redistribution of species in costal habitats, further associated with the beginning of the Middle Miocene Climate Optimum (Marx et al., 2019). These baleen whales also presented these characteristics: their body size was bigger than their Oligocene predecessors, with a body length of 5–8 meters, and were widely distributed geographically, the beginning of this Mysticeti cosmopolitanism being heralded by globally distributed genera such as *Pelocetus* Kellogg 1965 and *Parietobalaena* Kellogg 1924 (Marx et al., 2019).

Once, Miocene Cetotheriidae fossils from the Black Sea region were included only into the genus *Cetotherium*, thus this genus including nine nominal species: *Cetotherium rathkii* Brandt 1843, *C. priscum* Eichwald 1840, *C. helmersenii* Brandt, 1871, *C. mayeri* Brandt 1871, *C. riabinini* Hofstein 1948, *C. maicopicum* Spassky 1951, *C. incertum* Brandt 1873, *C. pusillum* Nordmann 1860, *C. klinderi* Brandt 1871, however new studies have severely decreasing the number of species attributed to this genus (Tarasenko & Lopatin, 2012; Tarasenko, 2014; Gol'din & Startsev, 2014; Gol'din et al., 2014; Gol'din & Startsev, 2017). The holotype of *C. incertum* represented by a vertebra fragment was lost, thus this species became nomen dubium, *C. helmersenii* was transferred into the genus *Eucetotherium*, as well as *C. maicopicum*, that was transferred into the genus *Kurdalagonus* (Tarasenko & Lopatin, 2012; Gol'din & Startsev, 2014, 2017). The case of *C. priscum* is discussed below.

Similar to the genus *Phoca*, the genus *Cetotherium* has also been used as a wastebasket taxon that included numerous species with a debatable taxonomic status, as discussed above. *Cetotherium priscum* (originally described as *Ziphidus priscus* Eichwald 1840) is the most widespread taxon attributed to this genus, from the Carpathian Foreland and Fore-

deep. The preserved fragments of the holotype include a mandible fragment and a caudal vertebra that lack diagnostic features, and cannot be included intro a specific genera or species, thus relegating this species to nomen dubium, further meaning that all specimens described as belonging to this species are placed under question (Gol'din & Startsev, 2017). Thus comes the necessity of redescription and taxonomical revision of material published by authors such as Nordmann (1860), Brandt (1873), Simionescu (1931), Nicolaescu (1933), Macarovici & Oescu (1941). Gol'din & Startsev (2017) suggest a temporal distribution of the baleen whale subfamily Cetotheriinae from the Late Serravallian —Tortonian and include five genera with seven species: *Cetotherium* (with *C. rathkii* and *C. riabinini*), *Brandtocetus* (with *Brandtocetus chongulek* Gol'din & Startsev 2014), *Kurdalagonus* (with *Kurdalagonus mchedlidzei* Tarasenko & Lopatin 2012), *Mithridatocetus* (with *Mithridatocetus eichwaldi* Gol'din & Startsev 2017 and *Mithridatocetus adygeicus* Tarasenko and Lopatin 2012) and *Zygiocetus* (with *Zygiocetus nartorum* Tarasenko 2014).

The paleogeographic distribution of Cetotheriidae includes various areas of the globe, several examples outside of the Paratethys being Portugal (Mocho & Póvoas, 2010), Belgium (Bisconti, 2013), The Netherlands (Marx et al., 2016), Peru (Bouetel & de Muizon, 2006; Bianucci & Collareta, 2022), Japan (Kimura & Hasegawa, 2010; Tanaka et al., 2018), United States of America (Ventimiglia, 2010; El Adli et al., 2014), various sites from Australia (Fitzgerald, 2004). Also worth mentioning is that while cetotheres are present both in the Paratethys Sea and in the North Atlantic Ocean, they are very rare in the area situated between these places, specifically the Mediterranean Sea (Collareta et al., 2021). The two groups of cetotheres from the North Atlantic and Paratethys had no contact with one another, that was reported thus far, given the fact that the subfamily Cetotheriinae is endemic to the Paratethys, the rarity of cetothere occurrences in the Mediterranean being explained by either competition with the eschrichtiines (grey whales) with similar feeding ecologies (even though another cetothere subfamily Herpetocetinae had no issues cohabitating with the eschrichtiine grey whales during the Pliocene), the lack of productive habitats or just the increased pressure of Mediterranean predators absent in the Paratethys (Gol'din et al., 2014; Collareta et al., 2021).

In the Paratethys Sea, members of the family Cetotheriidae were mentioned from Romania (Nicolaescu, 1931; Codrea, 2006; Grigorescu, 2018; Gol'din et al., 2020), Serbia (Gol'din & Radović, 2018), Bosnia and Herzegovina (Stefanović, 2010), Republic of Moldova (Macarovici & Oescu, 1941; Gol'din, 2018), Bulgaria (Simionescu, 1931), Ukraine (Gol'din et al., 2014; Gol'din & Startsev, 2014; Gol'din & Startsev, 2017), Russian Federation (Spasski, 1951; Pilleri, 1986), Georgia (Mchedlidze, 1964; 1988).

Conclusions

Cetotheriid remains from the Carpathian Foreland suffer from a lack of study. Only a few scientific papers have had the objective of analyzing fossil remains and taxonomical attribution was based only on material that lacks any diagnostic characteristics. This has had the effect of increasing the level of confusion regarding the taxonomy of cetotherians on Romanian territory. As such, a thorough review of cetotheriid remains and cetacean material in general is needed, to clarify the taxonomic situation of this group of marine mammals in the Romanian territory. The humerus is important from a palaeogeographical point of view, as this would be the first report of a different taxon other than those assigned to *Cetotherium*, from the Dacian Basin. Moreover, increased study of the Sarmatian s. l.

sedimentary deposits of the Dacian Basin will surely bring new cetotheriid material to light and will further add to the number of taxa from this part of the Paratethys.

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