

Fossil and subfossil record of vertebrate animals (Vertebrata J.-B. Lamarck, 1801) along the Western Black Sea Coast (Bulgaria)

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Abstract: In twenty-five sites along the Western Black Sea Coast of Bulgaria (Oligocene to subrecent) a total of 153 taxa were recorded: Osteichthyes – 3, Amphibia – 1, Reptilia - 6, Aves - 74, Mammalia - 69. Among them two taxa of birds and 37 taxa of mammals are fossil. One site is of Paleogene age, fourteen – of Neogene and ten – of Quaternary. Eight of the recorded species and one subspecies disappeared from the country during the historical era: *Caretta caretta*, *Chelonia mydas*, *Panthera leo*, *Bos primigenius*, *Castor fiber*, *Grus grus*, *Otis tarda*, *Bison bonasus* (now reintroduced), and *Equus ferus ferus*. In Dobrich Region were uncovered five sites, in Varna Region - ten, and in Burgas Region - ten. Neogene localities reveal occurrence of many taxa from the groups with a more southern recent distribution – proboscideans, hyaenids, equids, chalicotheriids, antelopes, etc.

Key words: Subfossil Osteichthyes, Subfossil Amphibia, Subfossil Reptilia, Fossil/subfossil Aves, Fossil/subfossil Mammalia, Black Sea fauna, Fossil/subfossil vertebrates of Bulgaria

Introduction

The geological history of the Western part of the Black Sea region was very complex. The West-Black-Sea Valley is the most important for the development of the Western Black Sea Coast. The Mesozoic bed of the West-Black-Sea Valley is covered by Paleocene-Eocene sediments of five km thickness. The Oligocene-Lower-Miocene deposits are also five km thick. Since middle Miocene until present the Black-Sea Depression developed as a united structure (PEYCHEV & PEEV 2006). The sinking of the sea bed continued in the Pliocene-Quaternary. The Pliocene-Quaternary sediments are thickest (up to three km) in the North-West part of the West-Black-Sea Valley. The connection of Black Sea with the Mediterranean and the Caspian seas in the Quaternary was periodically interrupted. In the transgression of the Caspian Sea a one-direction flow existed (a cascade of seas) from the Caspian Sea to Black Sea, Sea of Marmara and Mediterranean Sea. It appeared in the Ice Age at

low level of the World Ocean and the Mediterranean Sea. In the optima of interglacial periods the ocean water invaded Black Sea through the Dardanells, Sea of Marmara and the Bosphorus Strait. The connection between the Black Sea and the Caspian Sea was fulfilled through the Kuma-Manych Depression. The deep regression in the end of Pliocene and the early Pleistocene transformed drastically all river-valley systems of the Western Black Sea Coast. The Pliocene deposits proved that the coast line lied rather far from the modern sea coast (Fig. 1). The New-Euxinian regression between 30 000 to 8000 years BP formed a number of beaches, dunes and river bars in Bulgaria (PEYCHEV & PEEV 2006).

Recent fauna of vertebrates of Bulgaria numbers ca. 800 species, while the fossil/subfossil fauna of vertebrates includes about 600 species. The fossil and subfossil record of vertebrates along the Bulgarian Black Sea Coast remained so far

unexamined. Present paper is the first attempt to summarize all scattered data (published and unpublished) on the fossil vertebrates in the region.

Material and methods

The study was carried out at twenty-five coastal sites which chronostratigraphically cover a time scope from the Oligocene to subrecent times. The methods applied are described in detail in the papers on the relevant sites.

Results

Below are enlisted the species found in each of the studied sites (enlisted in historical order) with the relevant sources.

Paleogene: 1. **Kameno** (Burgas region) (Fig. 2). Oligocene. Sand quarry (NIKOLOV 1977a): *Brontotherium rummelicum*, *Cadurcodon* aff. *ardynense* (BAKALOV & NIKOLOV 1962); Brontotheriidae gen. (NIKOLOV 1963); **Neogene:** 2. **Balchik** (Dobrich region). Upper Sarmatian (Late Miocene): *Deinotherium bavaricum*, *Phoca* sp. - unpublished; Middle Miocene — Sarmatian, Upper Sarmatian (Hersonian) (NIKOLOV 1985); *Trilophodon angustidens* (BAKALOV & NIKOLOV 1962); Phoenicopteridae gen., sp. indet. (Fig. 3; BOEV 2011); *Choerolophodon pentelici* (MARKOV 2005); 3. **Aksakovo** (Varna region). Precise locality unknown, Middle Miocene-Sarmatian (NIKOLOV 1985); *Deinotherium giganteum* (BAKALOV & NIKOLOV 1962; VERGIEV & MARKOV 2010). *Prodeinotherium bavaricum* (MARKOV 2008); 4. **Varna – 1 (Pochivka quarter)** (Varna region). Middle Karaganian (Miocene) (KOJUMDGIEVA 1965): *Deinotherium bavaricum*, *Platybelodon* sp. – unpubl.; NIKOLOV (1985); 5. **Varna - 2 (City Center)** (Varna region). Middle Miocene, excavations during building works in Varna; end of October 2008. 15 eggs of Testudines fam. indet., matrix of marine sediments. Received from Prof. KRISTALINA STOYKOVA (Geological Institute, BAS) (Z. BOEV – unpubl.); 6. **Varna – 3 (Galata)** (Varna region). ?Turolian (Late Miocene). *Platybelodon* cf. *danovi* (MARKOV 2004, 2005, 2008); *Tetralophodon longirostris* (BAKALOV & NIKOLOV 1962); *Deinotherium giganteum* (MARKOV 2008); *Protanancus* sp. (MARKOV & VERGIEV 2010); 7. **Varna – 4** (Varna region). Precise locality unknown. Middle Miocene. *Tetralophodon* cf. *T. longirostris* (MARKOV & VERGIEV 2012). *Prodeinotherium bavaricum* (VERGIEV & MARKOV 2012); 8. **Yarebichna** (Varna region). Precise locality unknown. Probably Sarmatian (Late Miocene): *Deinotherium bavaricum* (BAKALOV & NIKOLOV

1962); *Dinotherium giganteum* (BAKALOV 1949; BAKALOV & NIKOLOV 1962; BOEV 2010); 9. **Staro Oryahovo** (Varna region). Early Miocene. *Protanancus* sp., *Prodeinotherium bavaricum* (VERGIEV 2016); 10. **Nesebar (Old Turkish Cemetery locality)** (Burgas region). Middle Sarmatian (Late Miocene): *Deinotherium* sp., *Hipparion* spp., Hyaenidae gen., *Machairodus* sp., *Schizochocerus* sp., *Anthracotheirus* sp., *Tragoceras* sp., *Gazella* sp., *Dorcatherium* sp., Phocidae gen., Delphinidae gen. (NIKOLOV 1977a); Nesebar, Turkish cemetery: *Hipparion nesebricum* (BAKALOV & NIKOLOV 1962), *H. praesulcatum*, *Deinotherium bavaricum*, *Schizochocerus vallesiensis* (BAKALOV & NIKOLOV 1962; NIKOLOV, 1971, 1985; NIKOLOV – unpubl.). *Deinotherium* sp. (NIKOLOV 1963); *Hipparion mediterraneum*, *H. nesebricum*, *Deinotherium giganteum* (BAKALOV & NIKOLOV 1962), *D. gigantissimum* (MARKOV 2004); 11. **Ravda** (Burgas region). Sarmatian (Late Miocene) (NIKOLOV 1977a): *Hipparion praesulcatum* (NIKOLOV 1971); 12. **Burgas – 1 (Burgas gulf)** (Burgas region). Turolian (Late Miocene): “Mastodon” remains from 8 m depth in front of the Central Beach of Burgas APOSTOLOV (1971); *Choerolophodon pentelici*, *Mammuthus primigenius* (MARKOV 2005); 13. **Burgas – 2** (Burgas region). Precise locality unknown. Meotian and Pontian, probably mixed fauna from different beds (Miocene) (NIKOLOV 1977a): *Gomphotherium (Trilophodon) angustidens*, *Choerolophodon (Synconolophus) serridentinoides*, *Aceratherium incisivum*, *Tetralophodon longirostris*, *Hipparion nesebricum*, *H. mediterraneum* (BAKALOV & NIKOLOV 1962 and unpubl.); *Aceratherium incisivum*, *Trilophodon angustidens*, “Mastodont” (BAKALOV 1927); *Mammuthus primigenius* (MILEVA 1974); “Mastodon” remains, excavated in 1900 in the region of the old railway station of Burgas (APOSTOLOV 1971); 14. **Sarafovo** (Burgas region). Miocene: *Palaeomeryx eminens* Meyer, *Chilotherium*; Pliocene: *Crociodura*, *Equus* L. “mastodont”, *Struthioniformes* fam. indet. (JAKUBOWSKI & KARASZEWSKI 1972); **Quaternary:** 15. **Tyulenovo** (Dobrich region). Pleistocene: Caves in cliffs near Tyulenovo v.: *Equus caballus fossilis* (NIKOLOV 1977b); 16. **Durankulak – 1** (Dobrich region). Middle Holocene. Neolithic - Early Chalcolithic settlement on the Golemiya Ostrov island in Durankulak Lake. ca. 6000-4000 BP (Excavations of Prof. HENRIETA TODOROVA in 1994-1996): “reptiles” (SPASSOV & ILIEV 2002); *Cygnus olor*, *Anser anser* (BOEV 1999); 17. **Yaylata** (Dobrich region). Middle Holocene. Rock niches in the Yaylata locality near Sveti Nikola v.: *Perdix perdix*, *Coturnix coturnix*,

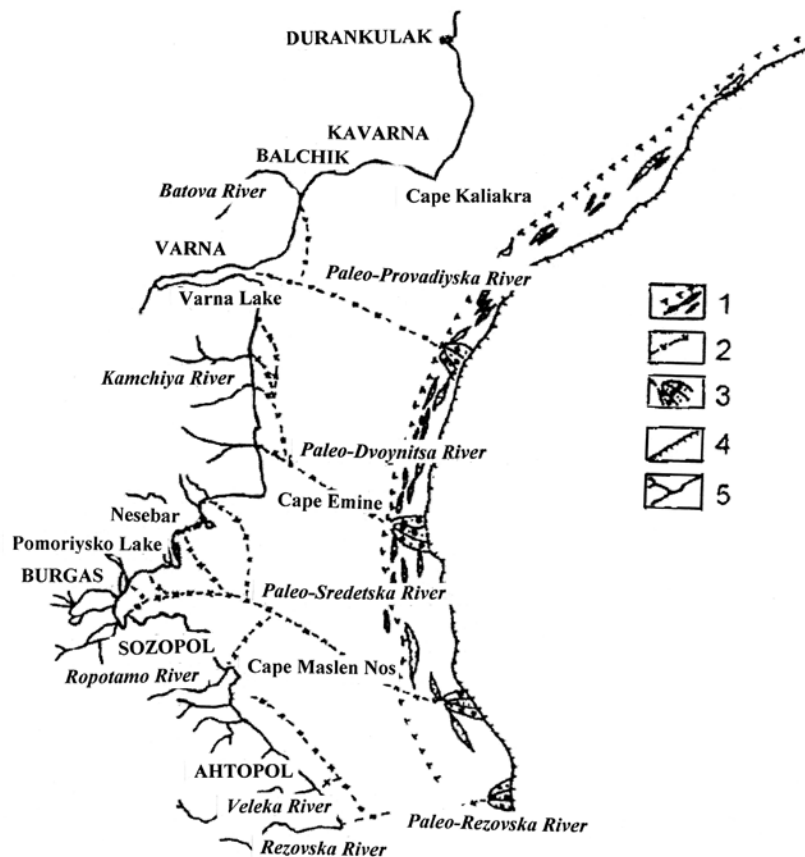


Fig. 1. Paleogeography of the Bulgarian shelf during last 18 000 years: 1 – New-Euxinian coast line with swells; 2 – river paleo-valleys; 3 – river paleo-deltas; 4 – shelf-continental slope border; 5 – recent coast line with river network (after PEYCHEV & PEEV 2006).

Gallinula chloropus, *Crex crex*, *Rallus aquaticus*, *Porzana* cf. *pusilla*, *Recurvirostra avosetta*, *Streptopelia turtur*, *Apus apus* (BOEV 1996, 1999); 18. **Orehite** (Dobrich region). Middle Holocene. Rock shelters in the Orehite locality near the Albena Resort: *Lullula arborea*, *Lanius collurio* (BOEV 1999); 19. **Burgas** – 3 (Burgas region). Middle Holocene. Early Chalcolithic: *Anser erythropus*, *Anser* sp. /cf. *A. anser*, *Ciconia ciconia*, cf. *Ciconia* sp., and *Fulica atra*. The site is the 2nd locality of extinct subspecies *Fulica atra pontica*; *Sus scrofa domestica*, *Ovis aries*, *Capra hircus*, *Bos taurus*, *B. primigenius*, *Ovis/Capra*, *Canis familiaris*, *Bison bonasus*, *Cervus elaphus*, *Dama dama*, *Capreolus capreolus*, *Lepus capensis*, *Erinaceus concolor* (probably misdated) (SPASSOV & ILIEV unpubl.); *Cervus elaphus*, *Cervus dama*, *Capreolus capreolus*, *Bos primigenius*, *Bison bonasus*, *Lepus europaeus* (SPASSOV & ILIEV 2008); 20. **Ezerovo** – 1 (Varna region). Middle Holocene. Late Chalcolithic – Early Bronze Age: *Tetrao urogallus*, *Anser anser*, *Aves* indet. (IVANOV & VASILEV 1979); “wild goose, capercaillie, swan” (TODOROVA 1979: 39); 21. **Sozopol** – 1 (Burgas region). Middle Holocene. Final Chalcolithic

(end of the 5th and the beginning of the 4th millennium BC) to the Early Bronze Age (2800–2400 BC; SPASSOV & ILIEV 1994). Submerged settlement in the Sozopol Bay of the Black Sea Coast, North-East to Sozopol town. The settlement was situated on a former island, now 12 m under water (GESHAKOVA & TOSHEV 1994). Excavations in 1987-1990 of MIHAIL LAZAROV, VESELIN DRAGANOV and HRISTINA ANGELOVA. *Emys orbicularis* of the Late Chalcolithic, *Testudo graeca* of the Late Chalcolithic, and of the Early Bronze Age); *Lepus europaeus*, *Felis silvestris*, *Panthera leo*, *Tursiops truncatus*, *Delphinus delphis*, *Sus scrofa*, *Cervus dama*, *C. elaphus*, *Capreolus capreolus*, *Bos primigenius*, *Equus* sp. (SPASSOV & ILIEV 1994). NMNHS. *Gavia arctica*, *Podiceps cristatus*, *Phalacrocorax carbo*, *Ardea cinerea*, *Anas querquedula*, *A. platyrhynchos*, *Aythya nyroca*, *Fulica atra*; *Cervus dama* (N. SPASSOV, G. RIBAROV – unpubl.); *Thunnus thynnus*, “Pisces sp. indet.”, *Testudo graeca*, *Emys orbicularis* (SPASSOV & ILIEV 1994); 22. **Urdoviza (Kiten)** (Burgas region). Middle Holocene. Chalcolithic-Early Bronze Age (3000-2000 BC). Submerged settlement on the former Black Sea coast Near the town of Kiten.

Excavations of M. LAZAROV, KRASIMIR POROZHANOV and VASIL POPOV. Reptilia - 2 (3) species (RIBAROV 1991b), 242 reptilian bone finds (BOEV & RIBAROV 1990). *Cygnus olor*, Aves indet., *Phalacrocorax carbo*, *Podiceps cristatus*, Anatinae gen., *Pelecanus onocrotalus*, Aythini gen., *Aythya ferina*, *A. nyroca*, cf. *Aythya nyroca*, *Podiceps nigricollis*, *Anser anser*, *Cygnus* sp., *Gavia stellata*, *Gavia arctica/stellata*, *Fulica atra*, *Anas platyrhynchos*, cf. *Phalacrocorax aristotelis* *Phalacrocorax carbo/aristotelis*, *Podiceps griseigena*, *Anser albifrons*, *Anser erythropus*, *Larus* sp., *Aythya* sp. - 1, *Aythya* sp. - 2, *Netta/Aythya* sp. - 1, *Netta/Aythya* - 2 sp., *Netta/Aythya* sp., *Vulpes vulpes*, *Canis lupus*, *Felis silvestris*, *Sus scrofa*, *Meles meles*, *Lutra lutra*, *Castor fiber*, *Cervus elapus*, *C. dama*, *Bos primigenius*, *Martes foina*, *Capreolus capreolus*, *Ursus arctos*, *Delphinus delphis*, *Equus* sp., *Canis* cf. *aureus*? *Equus przewalski gmellini* (RIBAROV 1991b); 23. **Durankulak – 2** (Dobrich region). Late Holocene. Ancient and medieval settlement (Excavations of Prof. H. TODOROVA (1990-1995): Testudines fam. indet.; *Anas platyrhynchos domestica*, *Gallus gallus domestica*, *Anser anser domestica*, and *Cygnus* sp.

(VASILEV 1989); *Cervus elaphus*, *Dama dama*, *Bison bonasus*, *Equus hydruntinus*, *Panthera leo*, *Gavia arctica*, *Podiceps cristatus*, *P. griseigena*, *Pelecanus onocrotalus*, *P. crispus*, *Pelecanus* sp., *Phalacrocorax carbo*, *P. aristotelis*, *Ciconia nigra*, *C. ciconia*, *Cygnus olor*, *C. cygnus*, *Cygnus* sp., *Anser anser* (domestica), *Anser anser*, *A. albifrons*, *Anser* sp., *Branta ruficollis*, *Anas platyrhynchos* (domesticus), *A. platyrhynchos*, *A. acuta*, *Anas penelope/ A. strepera*, *Spatula clypeata*, *Aythya fuligula*, *Bucephala clangula*, *Mergus merganser*, *Mergus albellus*, *Haliaeetus albicilla*, *Milvus* sp., *Circaetus gallicus*, *Accipiter gentilis*, *Buteo buteo*, *Aquila chrysaetos*, *A. heliaca*, *A. pomarina*, *Circus* sp., *Falco subbuteo*, *Perdix perdix*, *Grus grus*, *Otis tarda*, *Fulica atra*, *Larus argentatus*, *Columba oenas/ C. livia*, *Athene noctua*, *Corvus corone sardonius*, *Corvus* sp., *Bufo* sp., *Rutilus* sp. (MANHART 1998); *Equus caballus*, *Bos taurus*, *Capra hircus* (Z. BOEV – unpubl. data), *Mustela eversmanni* (N. SPASSOV – unpubl. data; BOEV 1991, 1996 c); *Bos primigenius*, *Cervus elaphus*, *Capreolus capreolus*, *Sus scrofa*, *Canis lupus*, *Vulpes vulpes*, *Meles meles*, *Lepus europeaeus*,

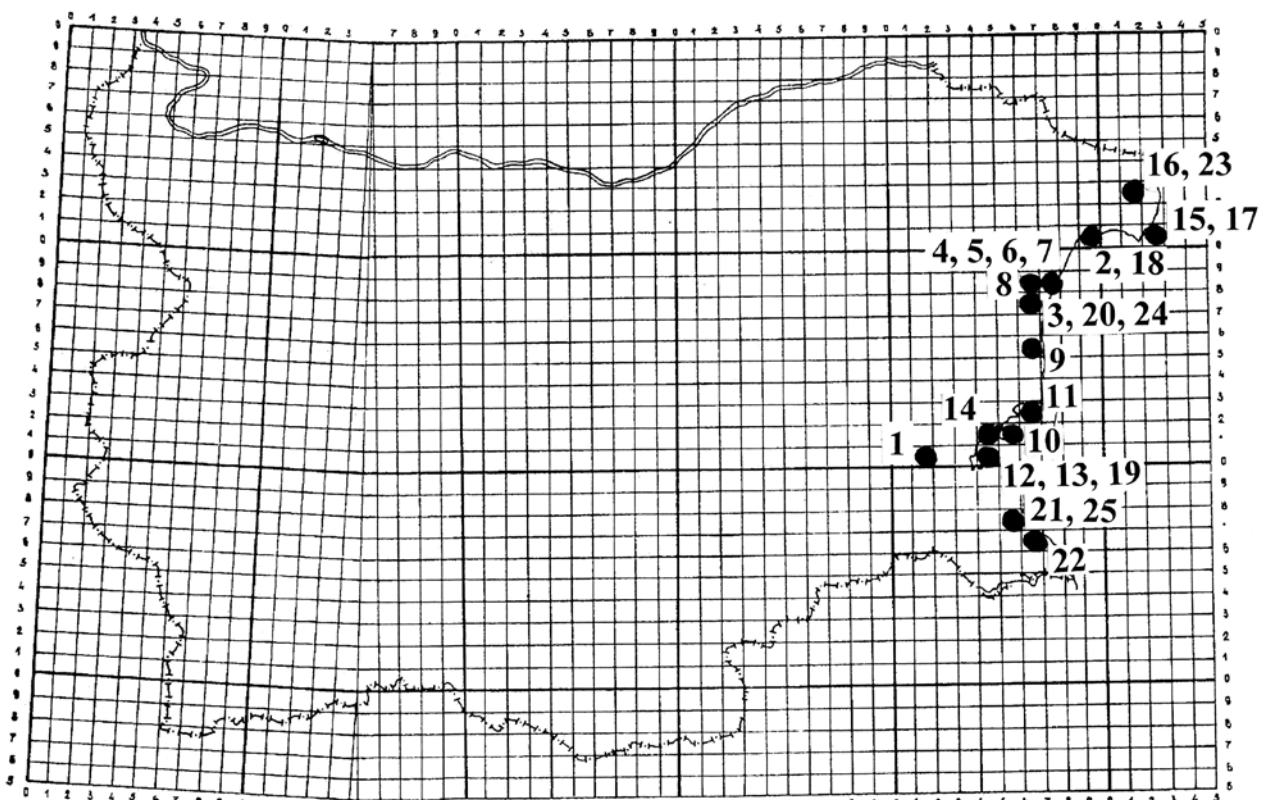


Fig. 2. Location of the sites of fossil/subfossil vertebrates along the Western Black Sea Coast (Bulgaria): Paleogene: Kameno (1); Neogene: Balchik (2), Aksakovo (3), Varna – 1 (Pochivka quarter) (4), Varna - 2 (5), Varna – 3 (Galata) (6), Varna – 4 (7), Yarebichna (8), Staro Oryahovo (9), Nesebar (Old Turkish Cemetery locality) (10), Ravda (11), Burgas – 1 (Burgas gulf) (12), Burgas – 2 (13), Sarafovo (14); Quaternary: Tyulenovo (15), Durankulak – 1 (16), Yaylata (17), Orehite (18), Burgas – 3 (19), Ezerovo – 1 (20), Sozopol – 1 (21), Urdoviza (Kiten) (22), Durankulak – 2 (23), Ezerovo – 2 (24), Sozopol – 2 (25).

Delphinus delphis (VASILEV 1989); 24. **Ezerovo – 2** (Varna region). Late Holocene. Medieval necropolis: “egg, chicken, hen” (IVANOV 1976); 25. **Sozopol – 2** (Burgas region). Late Holocene (subrecent, 1585; 1898). *Caretta caretta* - NANKINOV (1998) refers to Loggerhead turtle the observation of the French noble FRANCOIS DE PAVIE, Baron de Fourquevaux in 1585; *Chelonia mydas* - NANKINOV (1998) lists a specimen, caught on 16 November 1898. GEORGIEV (1979) also cites FRANCOISE DE PAVIE, who in his voyage along the Bulgarian Black Sea Coast in 1585 writes about numerous large “edible sea turtles (of the size of a ship boat) between towns of Sozopol and Balchik. They were often hunted for food by the crew. GEORGIEV (1979) supposes that the disappearance of the sea turtles in Black Sea is possibly caused by the overhunting by man in subrecent times, i. e. during the late Medieval ages.; *Chelonia mydas* captured November 1898 near Sozopol (BESHKOV 1987).

Discussion

The twenty-five sites listed above (Fig. 2) cover a time scope from the Oligocene to subrecent times and provide data on former distribution of a total of 153 species/taxa, as follows: bony fish – 3 taxa, amphibians – 1, reptiles - 6, birds - 74, mammals - 69. Among them 39 taxa (2 birds and 37 mammals) are fossil. Paleogene fauna is found in 1 site, Neogene – in 13, and Quaternary – in 10.

Neogene localities reveal occurrence of many taxa from the groups with more southern recent distribution – proboscideans, hyaenids, equids, chalicotheriids, antelopes, etc. Nine species disappeared from the country during the historical era: 2 reptiles (*Caretta caretta*, *Chelonia mydas*), 2 birds (*Grus grus*, *Otis tarda*; disappeared as breeding species), and 5 mammals (*Panthera leo*, *Bos primigenius*, *Castor fiber*, *Bison bonasus* (now reintroduced), *Equus przewalski gmellini* (now *E. ferus ferus*)). Two species are totally extinct (aurochs, European



Fig. 3. Fossil footprints of a flamingo (Phoenicopteridae gen. indet.), Late Miocene, Balchik. (Photo: Z. BOEV).

ass), and two species disappeared from Europe (lion and tarpan). Pliocene faunas are unknown so far in the Bulgarian paleontological sites along the Black Sea coast. Many rock niches between Kaliakra Cape and Tyulenovo village, the rocks of Emine Cape and Maslen Nos Cape probably contain fossils of that period. All Quaternary sites (except one) are middle to late Holocene and except two (Yaylata and Orehite) represent human settlements, mainly of Chalcolithic period. One site is in cave deposits, and three sites are below sea level and today lie on the sea bottom (Burgas – 1, Sozopol – 1 and Urdoviza).

Bulgarian Black Sea coast keeps extraordinary significant paleontological record of vertebrates and deserves special attention for its more exhaustive exploration.

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