ABSTRACT

The locality of Küçükçekmece has yielded a unique carnivoran fauna representing one of the rare fossil assemblages comprising both marine and terrestrial species. The studied sample comprises thirty-four specimens belonging to three different collections at the Technical University of Istanbul (ITU), Geology Museum of the Istanbul University (IU) and at the National Museum of Natural History of Paris. This low number of fossil remains contrasts with the relatively great taxonomic richness of the fauna, since six families and at least nine species are identified: the ursid *Indarctos arctoides* (Dépétet, 1895), the mustelid *Sivaonyx hessicus* (Lydekker, 1884), the phocids *Cryptophoca* sp. and *Phocidae gen. et sp. indet.*, the percrocutid *Dinocrocuta senyureki* (Ozansoy, 1957), the hyaenid cf. *Thalassictis sp.*, the felids *Machairodus aphanistus* (Kaup, 1832), *Pristifelis* sp. cf. *P. attica* (Wagner, 1857) and *Felidae gen. et sp. indet. medium size.* A tenth species, a small mustelid identified as *Mustela pentelici* Gaudry, 1861 by Malik & Nafiz (1933), was probably present. However, the figured (and only?) specimen was destroyed during the 1942 fire at Istanbul University. Most of the species are documented by one or a few specimens, while the phocid material is the most abundant and represents more than half of the described fossils, with many postcranial remains. The list of Carnivora of Küçükçekmece suggests a late Miocene age for the fauna of this site.
INTRODUCTION

Although it was discovered in the early 1930’s, the site of Küçükçekmece remains poorly known in the scientific community, with only a handful of recent work discussing or reporting on this locality (e.g., Rückert-Ülkümen & Kaya 1993; Koufos 2006). Of the twenty or so mammalian taxa that are present in the first faunal list published by Malik & Nafiz (1933), about one-third are of the order Carnivora: the mustelids Mustela pentelici Gaudry, 1861 and Lutra sp., the ursid Ursus sp., the hyaenid Ictitherium sp., the machairodontine felid Paramachairodus orientalis (Kirtl, 1887) (named Machaerodus orientalis in their contribution) and the phocid Phoca sp. Sayar (1953) added Machaerodus aphanistus (Kaup, 1832) to this list, but Yaçılıntar (1954) and Özansoy (1957) did not list this species and proposed the same faunal list as in Malik & Nafiz (1933). By comparison, Nicolas (1978) provided a somewhat different faunal list based on his own discoveries: the mustelids Lutra pontica Nordmann, 1858 and Sivanoxyx hesicus (Lydekker, 1884), the percrocutid Pterocrotina senyureki (Ozansoy, 1957), the hyaenid Ictitherium sp. cf. I. orbignyi (Gaudry & Lartet, 1856), the ursid Indarctos arctoides (Depéret, 1895), the felids Machairodus aphanistus (Kaup, 1832) and Felis sp. aff. F. priscus Kaup, 1833, indeterminate mustelids and viverrids, and the phocids Phoca maetowica Nordmann, 1860 and Phoca vindobonensis Toula, 1898. The carnivores from Küçükçekmece have never been described in detail and are infrequently mentioned in the literature, with one notable exception, however: the dental remains of the ursid were studied and assigned to Indarctos arctoides by Petter & Thomas (1986). The objectives of this paper are to describe in details the material from Küçükçekmece assigned to the Carnivora and to discuss its significance in the context of the late Miocene faunas of Europe and western Asia.

MATERIAL AND METHODS

The material from Küçükçekmece studied in this paper comes from three distinct collections. The specimens stored at the Muséum national d’Histoire naturelle, Paris (MNHN) were collected by the late Father Jean Nicolas between 1957 and 1967 (Nicolas 1978). Nicolas (1978) collected this material along the southwestern cliffs of the Küçükçekmece Lagoon and the adjacent shores of the Marmara Sea. In the present study this locality is called Küçükçekmece West and the specimens are labelled TRQ. The material housed at the Technical University of Istanbul (ITU) and at the Geology Museum of the Istanbul University (IU) issued from the excavations of Malik & Nafiz (1933) and later discoveries at the original Küçükçekmece locality, which is situated on the southeastern bank of the Küçükçekmece Lagoon. This locality is here called Küçükçekmece East and the specimens are labelled KÇ and IU, respectively. The 1942 fire at the Geological Institute of Istanbul University, where the collection of Malik & Nafiz (1933) was preserved, destroyed most of the specimens studied and/or figured by these authors (see Sen 2016). Both localities (Küçükçekmece East and West) are in the sandy-conglomeratic horizon of the Çukurçeşme Formation, and thus considered of the same age (see Lom et al. 2016; Sen 2016).

Lower case is used for lower teeth, upper case for upper teeth. All measurements are in mm and, unless otherwise noted, were taken with vernier callipers to the nearest 0.1 mm. Estimated measurements are labelled ‘est’ in tables and text. Anatomical nomenclature follows FIPAT (2011).

ABBREVIATIONS

| Abbreviation | Description |
|--------------|-------------|
| TLMd         | Total length of mandible |
| Lp1-4        | Length of p1-4 |
| DMP2-3       | Lingual depth of the dentary between p2 and p3 (or between any other teeth) |
| TMp3/m1      | Thickness of the dentary across p3/m1 |

Abbreviations

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SYSTEMATIC PALAEONTOLOGY

Order CARNIVORA Bowdich, 1821
Suborder CANIFORMIA Kretzoi, 1943
Family Ursidae Fischer, 1817

Genus Indarctos Pilgrim, 1913

TYPE SPECIES. — Indarctos salmantanus Pilgrim, 1913, by original designation.

Indarctos arctoides (Depéret, 1895)
(Fig. 1A, B)

Ursavus – Malik & Nafiz 1933: 109, pl. 12, fig. 6.

Indarctos arctoides – Petter & Thomas 1986: 579, figs 1-5.

REFERRED MATERIAL FROM KÜÇÜKÇEKMECE. — MNHN.F.TRQ947, subcomplete left hemimandible with the root of the canine, the root of p1, the alveolus of p2, the fused roots of p3, p4-m2, and the root of m3.

DESCRIPTION

Mandible (Fig. 1A, B)

The hemimandible is slender and low compared to other specimens of I. arctoides (for example, the holotype from Montredon, Depéret & Llueca 1928: pl. 9, figs 3, 4; the hemimandible from Yulaft, Geraads et al. 2005: fig. 2). However, it does not display any obvious pathology. The depth of the mandibular body is rather constant below p1-p4 (DMp2-3 = 39.3; DMp3-4 = 40; DMp4-m1 = 41), then increases slightly from m1 and posteriorly (DMm1-2 = 43.8; DMm2-3 = 46). Thickness of the dentary across p3 and m1 is 17.6 mm. The anterior margin of the fossa is situated below the distal border of m3. The ventral margin of the fossa is marked by a crest, which continues posteriorly to the tip of the angular process. The latter is short and extends medially by a small, dorsoventrally flat process. The process displays an additional, ventral crest marking the lateral extension of the internal pterygoid muscle insertion. This insertion is particularly visible in the lingual face of the mandible, where it occupies a dorsally curved, oval-shaped area of 35-mm length. The anterior limit of this area is marked by a conspicuous tubercle located ventrolingually on the mandibular body.

Dentition (Fig. 1A, B)

The p1, p2 and m3 are not preserved. The p1, p2 and m3 are single-rooted, with alveolar length of 9, 8.6 and 13 mm, respectively; the p3 has two roots that are mostly fused, for a total alveolar length of 12 mm. The tooth row is 125.5-mm long, from the mesial margin of the alveolus of p1 to the distal margin of the alveolus of m3. There is no distinct diastema between cheek teeth but a small one between p2 and p3 (L = 3 mm). The premolar row (L = 52 mm, measured at alveolar level) is much shorter than the molar row (L = 74 mm, measured at alveolar level). The teeth are lightly worn.
Sivaonyx hessicus | S. bathygnathus (Lydekker, 1884) | S. gandakasensis Pickford, 2007
---|---|---
KÇ 83 | BMNH 27486 | GSP 42251
GSI D 33 | NHM M 16929 | GSP 1170231
GSI D 250 | IVPP V 6886.81 | GSI D 2491
| | | NHM M 13175

The main cuspid of the p4 (L = 17.7; W = 9.4) is broken off and a small, mesiolingual fragment of the crown is missing. Distal and mesial accessory cuspsids are vestigial; the talonid is long, narrow, and marked by a central, longitudinal crest; it is bordered distally by a distinct cingulid. The m1 (L = 33; W = 15.7; TLm1 = 22.4) is elongated and low, especially the trigonid cuspsids. The protoconid is the tallest trigonid cuspid, the paraconid and metaconid being approximately of equal height. The paraconid and protoconid have an orientation parallel to that of the long axis of the body of the mandible. The metaconid is located distolingually to the protoconid and is visible in labial view. The labial face of the tooth is marked by a pronounced concavity at the trigonid/talonid junction. The talonid is much wider than the trigonid and the labial cingulid is particularly developed; its lingual (and not labial, contra Petter & Thomas 1986: 575) crest bears two low cuspsids, an entoconid distally, and a slightly larger and mesially located entoconulid. The *crista obliqua* is low and divides distad to the hypoconid, which is the only labial cuspid. The talonid basin is shallow. The m2 (L = 25.3; W = 17.6; TWm1 = 16.6) is rectangular in outline, with a trigonid slightly longer and, especially labially, wider than the talonid. The trigonid is composed of a horseshoe-shaped basin outlined mesially by a circular crest and distally by a transverse crest connecting protoconid and metaconid. The lingual margin of the talonid bears two vestigial cuspsids, the entoconulid being the most developed one. The hypoconid is partly broken and/or worn. The m3 is not preserved but its root is long and narrow.

Comparisons and Discussion

The genus *Indarctos* is a typical member of the late Miocene Holarctic faunas. In Eurasia, its species content is still disputed, with 2 to 5 species (see, for example, Hunt 1998; Baryshnikov 2002; Geraads et al. 2005). In Europe, three species are generally recognized, with evolution from MN9, *Indarctos vireti* Villalta & Crusafont, 1943, to MN12-13, *Indarctos atticus* (Weithofer, 1888), through the intermediate species *I. arctoides* (MN9-MN11). The first description and detailed comparison of the dentition of MNHN.F.TQR947 were made by Petter & Thomas (1986), who assigned TRQ947 (KUC 1 in their paper) to *Indarctos arctoides*. The main difference from their description that is worth noting here is the alveolar length of p1, 0.4 mm in Petter & Thomas (1986), a value difficult to reconcile with my measurement, 9 mm. The specific assignment of Petter & Thomas (1986) is based on the overall size of teeth (compared with the Turolian *Indarctos atticus*), and the single-rooted p2, especially compared with *Indarctos vireti* from Can Llobateres. In their study of *Indarctos arctoides* from the site of Yulafi (9.3-9.4 Ma, late Miocene, Thrace, Turkey) Geraads et al. (2005) also assigned the specimen from Küçükçekmece to *Indarctos arctoides*. In their discussion, they underline how difficult species demarcation is in this genus, but they conclude that *Indarctos arctoides* occurs only in the late Vallesian-early Turolian, while *I. atticus* is known from later Turolian sites. There is little I can add here to support this assignment. A major contribution to the knowledge of *I. arctoides* will certainly come when the extraordinary sample from the Vallesian site of Batallones-3, Spain, which yielded approximately 2000 bones of this species representing a minimum of 16 individuals (Abella et al. 2013) is published.

The M2 assigned to *Ursavus* sp. figured by Malik & Nafiz (1933; fig. 6) probably belongs to the same species (see discussion in Petter & Thomas 1986). This specimen was part of the collection stored at the Geology Institute of Istanbul University and was probably destroyed by the fire of 1942.

Family Mustelidae Fischer, 1817

Genus *Sivaonyx* Pilgrim, 1931

Type species. — *Sivaonyx bathygnathus* (Lydekker, 1884) by original designation.

*Sivaonyx hessicus* (Lydekker, 1890)
(Fig. 1C-E; Table 1)

*Lutra* sp. — Malik & Nafiz 1933: 32, 66, 109. — Yağchınlar 1954: 112. — Ozansoy 1957: 33.

Referred Material from Küçükçekmece. — KÇ 83, fragment of right hemimandible with m1.

Description

A small portion of the dentary is preserved (Fig. 1C-E); at the level of the carnassial it is thick and deeper than the length of the m1.

The carnassial is typical of lutrines. It is robust, elongated though low and wide. The trigonid cuspsids are low and of approximately equal height; the metaconid is strong and slightly...
Fig. 1. — A, B, Indarctos arctoides (Depéret, 1895): MNHN.F.TRO947, subcomplete left hemimandible with p4-m2 in labial (A) and occlusal (B) views; C-E, Sivamonyx hessicus (Lydekker, 1890): KÇ 83, fragment of right hemimandible with m1 in lingual (C), occlusal (D), and labial (E) views; F-H, Cryptophoca sp.: KÇ 101, fragment of left hemimandible in occlusal (F), lingual (G), and labial (H) views. Scale bars: 10 mm.
distal to the protoconid; the paraconid is large, triangular in occlusal shape, and occupies nearly the entire mesial half of the trigonid; its distal face is transversely oriented. A prominent crest (= protoconulid, in Morales & Pickford 2005; = post-paraconid cusp, in Pickford 2007) is present at the distal base of the protoconid; faint notches separate this crest from the protoconid and the hypoconid crest of the talonid. The trigonid basin is deep and opened lingually so that the paraconid and metaconid are deeply separated. A strong cingulid is present on the labial side of the crown and on the lingual side of the paraconid. The talonid is wide and rounded, with a shallow basin; the hypoconid crest is wide (the lingual slope occupies one-half of the talonid width) and tall relative to the lingual ridge. The hypoconid is poorly individualized, but is slightly prominent relative to the distal rim of the talonid. The tooth has its maximum width approximately at the trigonid/talonid boundary.

Comparisons and Discussion

The generic assignment of the material is based on a comparison with most of the late Miocene and Pliocene species of lutrines. Besides the robustness of the dentary, which is hard to estimate here, species of Sivaonyx are characterized by "an m1 with a low trigonid with cuspids of approximately equal height, deeply separated paraconid and metaconid, a talonid wider than the trigonid, a large hypoconid crest, a shallow talonid basin, a low but distinct entoconid crest, a cingulid marked on the labial side that may extend on to the lingual side of the paraconid" (Peigné et al. 2008: 795). These features are present in KÇ 83. An additional diagnostic feature of the species of Sivaonyx mentioned by Pickford (2007) is mandibular depth greater than m1 length, which is also observed in KÇ 83, but this may also be the case in non-bunodont otters such as Lutra spp. (personal observations). The specimen from Küçükçekmece differs from Visnuonyx Pilgrim, 1932 (and extant genera such as Lutra Brisson, 1762) in having an m1 that is more bunodont and with a lower relative talonid to the talonid, and from more bunodont taxa (e.g., Euhydridodon Falconer, 1868, Djuwanaus Peigné et al. 2008) in having an m1 that is less bunodont and a more slender dentary.

Many species of Sivaonyx have been described, especially from Africa and southern Asia (Morales & Pickford 2005; Pickford 2007; Peigné et al. 2008; Werdelin & Peigné 2010). Most of these species have an m1 with a wider talonid and, generally, a larger size than the specimen from Turkey described here (Table 1). In addition, according to Pickford (2007), S. gandakasensis Pickford, 2007 has also a shorter trigonid (57-64%) than in S. hessicus.

The specific assignment is based on a comparison with the holotype and single specimen of the European species originally described as Lutra hessica, BMNH 27486. This specimen is a fragment of right hemimandible with a fragment of p4 and m1 from the German locality of Eppelsheim (MN9, late Miocene). The geographic and stratigraphical proximity of the specimens of Eppelsheim and Küçükçekmece, in addition to their morphological similarity, support their assignment to the same species. Additional material is required to confirm this hypothesis. Because the specimen from Eppelsheim displays the diagnostic features of the genus Sivaonyx mentioned above, I propose to name this species Sivaonyx hessicus, an hypothesis already suggested by Morales & Pickford (2005) and, especially, by Pickford (2007). As noted by Pickford (2007), however, there is not much difference between Sivaonyx hessicus and the type species of the genus, S. bathygnathus. The species from Germany and Turkey may prove to be synonymous with this Asiatic species when more material is known. In his review of the Pliocene and Quaternary European otters, Willemens (1992) concluded that the morphology of the m1 of Lutra hessica suggested a closer relationship to Lutrini (i.e. Lutra, Lutrogale Gray, 1865, Pteronura Gray, 1837 and their fossil relatives; see Willemens 1992: 114), but his comparison was biased since he did not compare Lutra hessica with the species of Sivaonyx, of which many species have been described since then.

Family Phocidae Gray, 1821

Genus Cryptophoca Koretsky & Ray, 1994

Type species. — Cryptophoca maeotica (Nordmann, 1860), by original designation.

Cryptophoca sp.

(Figs 1F-H, 2, 3, 4A, B; Tables 2, 3, 4)

Phoca sp. – Malik & Nafiz 1933: 110, pl. 13, figs 1-3. Uncertain synonymy.

Referred material from Küçükçekmece. — KÇ 101, fragment of left hemimandible with roots of p2-4; MNHN.F.TRQ930, proximal two thirds of right humerus; TRQ933, proximal fragment of left humerus; TRQ935, distal half of right humerus; TRQ297, distal half of left radius; TRQ295, proximal half of left ulna; TRQ296, proximal fragment of right ulna; TRQ944, left femur without epiphysis; TRQ945, distal fragment of left femur without epiphysis; TRQ943, distal fragment of right tibia; TRQ915, distal fragment of left tibia; TRQ917, distal fragment of left tibia; TRQ918, distal fragment of left tibia; TRQ928, subcomplete left astragalus.

Table 2. — Measurements (in mm) of the dentary of Cryptophoca sp. from Küçükçekmece and comparisons with some Miocene phocids from Europe. Symbols: 1, from Koretsky & Ray (1994); 2, from Koretsky (2001). Numbers between brackets indicate sample size. See Material and methods for abbreviations.

| Cryptophoca sp. | C. maeotica (Nordmann, 1860) | P. pannonica Kretzoi, 1941 | P. vindobonensis (Toula, 1897) | L. lenis True, 1906 |
|----------------|-----------------------------|----------------------------|----------------------------|------------------|
| Lp1-m1         | KÇ 101                      | range 31.5-38 (2)          | juvenile 34                | range 47-51 (9)  |
|                | 48                          |                            |                            |                  |
Fig. 2. — Postcranium of Cryptophoca sp., forelimb: A, B, MNHN.F.TRQ930: proximal fragment of right humerus in posterior (A) and proximal (B) views; C-E, TRQ935: distal fragment of right humerus in medial (C), posterior (D), and anterior (E) views; F, G, TRQ925: proximal fragment of left ulna in anterior (F) and lateral (G) views; H, I, TRQ927: distal fragment of left radius in lateral (H) and distal (I) views. Numbers refer to grooves on the lateral face of the radius, which are assigned to the tendon for the M. abductor pollicis longus (1), the M. extensor digitorum communis and/or the M. extensor carpi radialis (2), the M. extensor digitorum lateralis (3), and M. extensor pollicis longus (4). Scale bar: 10 mm.
The tooth row (p1-m1, alveoli) is 48-mm long. The tooth longest diastema is the one between p4 and m1 (L = 4 mm). From p2 to m1. The greatest diameter of the alveolus of p1 biradiculate. Alveolar lengths indicate an increasing length to the preserved alveoli the p1 was large (nearly as large as below p3 and the diastema between p3 and p4. According to the preserved alveoli the p1 was large (nearly as large as the canine) and single-rooted, and the p2, p3, p4, m1 were

dentary tapers below p4-m1 (DMp4-m1 = 18.6), where the ventral rim of the body shows a marked convexity. This convexity has vari-
Fig. 3. — Postcranial of Cryptophoca sp., hind limb: A, B, MNHN.FTRQ944: left femur in anterior (A) and posterior (B) views; C, D, TRQ945: distal fragment of left femur in anterior (C) and posterior (D) views; E-H, TRQ918: distal fragment of left tibia in medial (E), posterior (F), anterior (G), and distal (H) views. Scale bar: 10 mm.
extends proximal to the distalmost point of the deltopectoral crest. The epicondylar crest projects mainly posteriorly and poorly laterad; the lateral rim of its anterior face is marked by attachments for the extensor muscles of the manus. It is not possible to compare directly the distal and the proximal epiphysis, but TRQ933 and TRQ935 appear to be adequately complementary, hence providing a good idea of the complete bone. The distal epiphysis is narrow, probably narrower than the proximal epiphysis, or of approximately equal width. The medial epicondyle is broad and anteroposteriorly flattened. An entepicondylar foramen is present. The olecranon fossa is nearly flat and the coronoid fossa is shallow. In anterior view, the capitulum is much more so than in extant phocids (Howell 1929: fig. 10). A small facet for the M. extensor pollicis longus, as in Praepusa vindobonensis, is convex, while the posterior rim is slightly concave. At least four grooves are present on the lateral surface for the tendons of extensor muscles of the manus. I interpret these grooves following the anatomical descriptions of Howell (1929) and Piérard (1971). The groove that obliquely crosses the distal region of the lateral side of the radius in a posteroproximal to anterodistal direction is particularly deep in the anterodistal corner. The position and the course of this groove indicate that this is the one for the tendon of the M. abductor pollicis longus (see Piérard 1971: fig. 20; Fig. 2H). A wide, smooth groove located just posterior to it is interpreted as the groove for the M. extensor digitorum communis and/or that for the M. extensor carpi radialis; these two tendons are very close one to another but are not always associated with a groove in extant phocids (Piérard 1971). In the proximal part of TRQ297 this groove is visible along the anterior rim of the radius; distally it crosses the groove for the tendon of the M. abductor pollicis longus. A wide and low ridge separates this groove from two distinct grooves that are certainly for the tendons of the M. extensor digitorum communis and, more posteriorly, the M. extensor pollicis longus, as in extant phocids (Howell 1929: fig. 10). A small facet for the scapholunar occupies the distal epiphysis; it is concavoconvex and, in distal view, figure-8 shaped. Distally, the posterior side is flattened and occupied by the facet for the ulna, which is elliptical and slightly depressed.

**Femur** (Fig. 3A-D; Table 4). The two specimens from Küçükçekmece West do not preserve the epiphysis and certainly belong to juvenile or young adult individuals. The absence of a deep trochanteric fossa in MNHN.E.TRQ944...
Fig. 4. — A, B, Cryptophoca sp.: MNHN.FR.9928, subcomplete left astragalus in ventral (A) and dorsal (B) views; C–H, Phocidae gen. et sp. indet.: C, D, TRQ932, proximal fragment of right humerus in anterior (C), proximal (D), and lateral (E) views; F–H, TRQ946, left tibia and proximal fragment of fibula in proximal (F), posterior (G), and anterior (H) views. Scale bars: 10 mm.
is most probably a juvenile feature, hence has no pertinent taxonomic value. The lesser trochanter is absent. The greater trochanter is large, anteroposteriorly flattened and extended proximal to the femoral head. Its proximomedial part extends posteriorly above the trochanteric fossa (nearly absent/not yet developed in TRQ944). The neck is short. The shaft is strongly anteroposteriorly flattened and has a lateral and, especially, a medial rim that is particularly thin at mid-length. The intercondylar fossa is shallow. The main difference between TRQ944 and TRQ945 is that the latter shows a greater medial expansion of the medial epicondyle of the distal epiphysis. As TRQ945 belongs to a larger individual this difference may result from an ontogenetic difference. Indeed Koretsky (2001: 25) mentioned that juveniles tend to have limb bones where the proximal and distal epiphyses are not much different, while in adults the distal epiphysis is “distended considerably” compared to the proximal epiphysis.

Tibia (Fig. 3E-H; Table 4). The four distal extremities assigned to Cryptophoca sp. have nearly the same size and proportions, MNHN.F.TRQ917 being slightly larger. They all have similar morphology, except in the length of the preserved portion of the shaft. In its proximalmost part, the shaft is triangular in cross-section, then becomes more quadrangular distally. Distally on the medial face, there is a flattened, elongated triangular area corresponding to the surface of contact with the fibula. The medial side of the posterior face is marked distally by two grooves, interpreted here as those for the tendon of the M. flexor digitorum longus and, more medially, for the tendon of the M. tibialis posterior (Pierard 1971: fig. 32). The grooves are well distinct in TRQ916 and TRQ913, but less so in TRQ917 and TRQ918, where only one groove is clearly identified. Lateral to these grooves, the tibia is convex and slightly bulged. The anterior face is marked by a wide groove, assigned to the one for the tendons of Mm. tibialis anterior and extensor hallucis longus. The anterior distal rim of the tibia extends distally to the level of the medial malleolus. The distal epiphysis is occupied almost entirely by the facet for the astragulus, which is strongly concave. Laterally the articular surface is inclined proximally, contrasting with the medial malleolus, which extends distally.

Astragulus (Fig. 4A, B; Table 4). The bone is poorly preserved. The calcaneal process is broken off and the articular facets are not well visible. The superior facet is proximodistally convex and mediolaterally flat. The neck is long and poorly deviated medially. The head, with an articular facet for the navicular, is flat distally and convex ventrally: the facet extends along the ventrolateral face of the neck. The facets for the calcaneus are not well distinct; the sustentaculum facet is narrow, convex and connected to the distal facet (for the navicular); the ectal facet is concave, wider, and separated from the sustentaculum facet by a shallow groove where a minute foramen is visible. The facet for the fibula occupies the entire lateral face of the body.

COMPARISONS AND DISCUSSION
Malik & Nafiz (1933: pl. 13, figs 1-3) figured and briefly described a craniodental material that was much more complete than that available today. Since their study, a fire destroyed all the specimens figured. The material found by Nicolas (1978) includes only post-cranial, mostly incomplete, elements.

Fossil phocids are abundant in late Miocene localities of Central Europe and the western and northern Black Sea region. In her review of the Miocene Phocinae Gray, 1821 of Europe Koretsky (2001: table 1) mentioned the species Monachopsis pontica (Eichwald, 1850) from Turkey, though no detail regarding the locality is mentioned. Among the many fossil Phocinae present in the middle and late Miocene of Europe, less than ten are known in eastern Europe, especially in the Black Sea region: Praepusa pannonica Koretsky, 1941, P. vindobonensis (Toula, 1897), P. magyaricus Koretsky, 2003, Sarmatonectes sintsovi Koretsky, 2001, Histriophoca alekseevi Koretsky, 2001, Monachopsis pontica and Cryptophoca maeotica. The taxonomic nomenclature follows Koretsky (2001). I also include in the comparisons Pontophoca sarmatica (Alekseev, 1924), known from late Miocene strata of the same Black Sea region; Koretsky (2001) assigned this species to the Monachinae Gray, 1869.

There is a great variability of body size among these late Miocene species. Cryptophoca sp. from Turkey is a rather small species though a part of the material probably belongs to juveniles. Nevertheless I do not consider size as a pertinent character for taxonomic assignment. Pinnipeds generally show a marked sexual size (and morphological) dimorphism, but this is partly due to relative development of soft tissue (muscles, fat). Sexual dimorphism of bones does exist, and deals not only with size but also with the anatomy, which is worth knowing in the present context. In fossil seals, sexual dimorphism is generally not documented due to a lack of pertinent material. However, Koretsky (2001) provides differential measurements and traits for (supposed) males and females of Monachopsis pontica, which is one of the best-known late Miocene species. Praepusa vindobonensis also shows a great size variability (Koretsky 2001). Below I therefore discuss chiefly anatomical differences rather than size differences.

Dentary
Morphologically the hemimandible from Kucukcekmece East closely resembles that of Cryptophoca maeotica illustrated by Koretsky & Ray (1994: fig. 1) and Koretsky (2001: fig. 33): same development and position of the mental protuberance, largesized and single-rooted p1, presence of diastemata between cheek teeth, development and length of the symphysis (straightness of the ventral rim, expansion not posterior to p2 mesial alveolus). The features that may represent autapomorphies for KÇ 101 and C. maeotica are the large size of the single-rooted p1 and the morphology of the anterior part of the dentary (symphysis length, ventral border straight). In these features these taxa differ from the species assigned to Praepusa Kretzoi, 1941, Histriophoca Gill, 1873, Monachopsis Kretzoi, 1941 and Pontophoca Kretzoi, 1941. KÇ 101 differs from C. maeotica in being smaller in size (by approximately 20%, based on illustrations of the tooth row of C. maeotica, Koretsky & Ray 1994: fig. 1; Koretsky 2001: fig. 33) and in having an m1 longer than p4 (based on alveolar length).
Postcranial

Comparison with *C. maeotica*. The humerus (MNHN.F. TRQ930, TRQ933, TRQ935) also fits the description of the same element in *C. maeotica* by Koretsky & Ray (1994) and Koretsky (2001): deltopectoral crest strong and long (though not reaching the coronoid fossa), lesser and greater tubercles at the same level and higher than the head, epicondylar crest reaching the distal part of the deltopectoral crest proximally. The fragmentary femora (TRQ944, TRQ945) belong to juveniles. They have a greater trochanter that is much higher than the head and a distal epiphysis that is only slightly wider than the proximal epiphysis, like in *Cryptophoca maeotica* (Koretsky 2001: fig. 35).

Comparison with *M. pontica*. The description of the humerus from Küçükçekmece West also fits with that of the humerus of *Monachopsis pontica*. Given the sexual dimorphism observed in the latter (Koretsky 2001) the distinction between the humeri of these species is not easy. According to the diagnosis of *M. pontica* provided by Koretsky, the humerus fragments from Turkey differ from the humerus of *M. pontica* in the absence of dorsoventral compression of the head and a shorter deltopectoral crest. However, the compression of the head in *M. pontica* is a highly variable, sexually dimorphic trait: the males have a dorsoventrally compressed humeral head, while the females do not (Koretsky 2001: tables 2, 6). Koretsky (2001: fig. 17, table 7) describes the strong morphological and metrical sexual dimorphism of the femora of *M. pontica*. Juvenile characters may add to this dimorphism. The femora from Küçükçekmece West cannot readily be distinguished from those of *M. pontica*. A single astragalus of *M. pontica* has been described (Grigorescu 1976: fig. 6). The description does not allow distinction from MNHN.F. TRQ928 but the figures show that the distal region of the astragalus of *M. pontica* (neck and head especially) are much more robust and wider relative to the body than in TRQ928.

Comparison with *Praepusa* spp. Compared to the material from Küçükçekmece West *Praepusa* spp. have a more slender humerus with a dorsoventrally compressed head, a sharper deltopectoral crest, a lesser tubercle that is less protruding (and elongated along the shaft axis) and a distal epiphysis that is wider relative to the proximal epiphysis (Koretsky 2001: figs 24, 28; Koretsky 2003), an ulna with a shaft that is more mediolaterally compressed and an olecranon process that is wider relative to the proximal epiphysis (Koretsky 2001: fig. 2). Koretsky (2001: fig. 26), though *P. magyaricus* has an ulna with a similar development of the olecranon (Koretsky 2003: fig. 2), Koretsky does not describe the radius and tibia of *P. vindobonensis* in detail, but their measurements and proportions do not differ markedly from the same elements from Küçükçekmece West (Koretsky 2001: figs 27, 28, 31, tables 10, 12).

Comparison with *P. sarmatica*. Based on Koretsky & Grigorescu (2002) and Koretsky et al. (2014), the material from Küçükçekmece differs from *Pontophoca sarmatica* (and this is also true for *P. julandica* Koretsky, Rahmat & Peters, 2014 though not from eastern Europe) in having a single-rooted p1, a humerus with a longer deltopectoral crest, a more reduced epicondylar crest, a distal epiphysis (probably) narrower than the proximal epiphysis, and a femur with a higher greater trochanter and a distal epiphysis that is proportionally narrower, though exceeding the width of the proximal epiphysis.

The ulnae, radii, tibiae and astragali from Küçükçekmece West cannot be compared with all the late Miocene phocids of Europe due to lack of comparative data; only some of these bones may be compared to one or several taxa (see above the comparisons with *Praepusa* spp. and *M. pontica*). They are provisionally assigned to the same species as the dentary, humeri and femora based on their size. Given the difficulty of generic assignment of fragmentary specimens, the material assigned here to *Cryptophoca* sp. may prove to represent more than one species.

**Table 4.** — Measurements (in mm) of Phocidae gen. et sp. indet. from Küçükçekmece. Measurements follow Koretsky (2001: fig. 5). For comparisons and abbreviations, see Table 4.

| Humerus | MNHN.F. TRQ932 |
|---------|----------------|
| ML W head | 22.4 |
| H head | 19.8 |
| prox ML W | 30 |
| prox AP T | 41.4 |

| Tibia | MNHN.F. TRQ946 | MNHN.F. TRQ922 |
|-------|----------------|----------------|
| L | 172.5 |
| prox ML W prox (tibia + fibula) | 49.2 |
| prox ML W tibia | 42 |
| prox AP T tibia | 22.8 |
| dist ML W | 23.3 |
| dist AP T | 20.3 |

**Table 5.** — Measurements (in mm) of Phocidae gen. et sp. indet. from Küçükçekmece. Measurements follow Koretsky (2001: fig. 5). For comparisons and abbreviations, see Table 4.

| Humerus | MNHN.F. TRQ932 |
|---------|----------------|
| ML W head | 22.4 |
| H head | 19.8 |
| prox ML W | 30 |
| prox AP T | 41.4 |

**Referred material from Küçükçekmece.** — MNHN.F. TRQ932, proximal fragment of right humerus; TRQ946, left tibia and proximal fragment of fibula; TRQ922, distal fragment of right tibia; TRQ293, proximal fragment of left Mt I.

**Description**

**Humerus (Fig. 4C, D; Table 5).**

*MNHN.F. TRQ932* belongs to a much larger specimen than those represented by *Cryptophoca* sp. The tubercles are developed and slightly higher than the humeral head. The latter is less rounded than in the specimens of *Cryptophoca* sp. described above, showing dorsoventral compression.

**Tibia-fibula (Fig. 4F-H; Table 5).**

The tibia and fibula are fused proximally (MNHN.F. TRQ946). Both articular facets for the femoral condyles are well-de-
finely and slightly concave. The lateral condyle is larger and more elliptical than the medial one. Just distally, and rather lateral, to the proximal epiphysis, there is a deep and short tibial fossa on the anterior and posterior faces. The anterior fossa is much shorter than the posterior fossa. The shaft is triangular in cross section; minimal diameters are measured slightly distal to mid-length (minimum mediolateral width is 14.6 mm, anteroposterior thickness is 13 mm at the same level). The distal part of the shaft and the distal epiphysis in TRQ922 and TRQ946 are not different from those of the specimens assigned to Cryptophoca sp. described above. The distal tip of the medial malleolus of TRQ922 is broken off. The grooves observed in the latter are visible in TRQ922, but in TRQ946 a single wide groove is distinct on the posterior face.

Approximately 30 mm of the distal fibula are preserved in TRQ946. The shaft is nearly T-shaped, with a posterior face divided by a sharp crest into two subequal parts. The anterior face of the shaft is slightly depressed by a fossa that may be the insertion area of the M. extensor digitalis lateralis, as in extant phocids (Piéard 1971). Relative to the proximal face of the tibia, the proximal face of the fibula is inclined laterally distal.

**Mt I (Table 5)**

MNHN.F.TRQ923 may represent the proximal half of an Mt I. This identification is based on the morphology of the proximal epiphysis, which shows a strong concavity that may correspond to the articulation with the medial cuneiform; a small apophysis extending proximally is also present in the ventrolateral corner. Laterally, the facet for the Mt II is hardly visible.

**Comparisons and Discussion**

The fragmentary humerus MNHN.F.TRQ932 belongs to a much larger specimen than those represented by Cryptophoca sp. Besides, its morphology differs from that of TRQ930 and 933 by having a deltoid tubercle located more proximally, a lesser tubercle oriented more medially, hence a much wider intertubercular sulcus, and a dorsoventrally compressed head. The latter character is also a characteristic of Monachopsis pontica and of some species of *Praepusa* (Koretsky 2001).

**Dinocrocuta senyureki** (Ozansoy, 1957) from Küçükçekmece; specimens TRQ are stored in the MACA. See Material and methods for additional abbreviations.

**Table 6. — Measurements (in mm) of Dinocrocuta senyureki** (Ozansoy, 1957) from Küçükçekmece compared with other Percrocutidae: lower dentition. Symbols: *m*, mean (of left and right sides); *t*, type specimen; *f*, from Viranta & Werdelin (2003); *h*, from Howell (1987); *s*, from Schlosser (1903); *z*, from Zhang (2005); *k*, from Zhang & Xue (1996); *o*, from Kouts (1995). Abbreviations: *pC diast*, post-canine diastema; *Küpik*, Küçükçekmece; *Yass., Yasilioren*; *Pent.*, Pentaphlops; *D. m.*, Dinocrocuta minor (Ozansoy, 1965); *D. a.*, *D. algeriensis* (Arambourg, 1959). Specimens from Bou Hanifia are stored in the MNHN under the acronym “MNHN.F.-1951.9-”; specimens TRQ are from MNHN.F Collection; specimens labelled ‘AS’ and ‘S’ are stored in the MACA. See Material and methods for additional abbreviations.

| **Dinocrocuta senyureki** | **D. m.** | **D. a.** | **Dinocrocuta gigantea** (Schlosser, 1903) |
|------------------------|----------|----------|----------------------------------------|
| Küçük. | TRQ | TRQ | TRQ | AS.95, AS.95, S.89. | TRQ | TRQ | TRQ | 172 | 29 | TRQ |
| TRQ | TRQ | TRQ | 1010 | 1009 | 318 | 2801 | 1381 | 2P28A2 | 1011 | 1 |
| pC diast | L | 15.5 | 13 | 8 | - | - | - | 9 | 10.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| p2 | L | 22.7 | 22.3est | 24 | 22.9 | - | - | - | 21est | 18.1 | 24.1 | 25 | 24 | 30.4 | 27.6 | 25.5 | 29.2 | 27 |
| W | 13.9 | 14.8 | 15.9 | 16.3 | - | - | 15.5est | 9.8 | 16.5 | 16.3 | 17.5 | 20.7 | 18.1 | 16 | 19.1 | 19 |
| p3 | L | 26est | - | 27.4 | 25.9 | 26.3 | - | 26.7 | 20.1 | 25.1 | 26.7 | 28 | 32 | 30.5 | 30.5 | 28.7 | 28.7 |
| W | 15est | - | 17 | 17 | 17.5 | 16.7 | - | 17.3est | 12.8 | 17.3 | 18 | 19 | 21 | 19 | 17.5 | 21.3 | 19.5 |
| KÇ | 58 | |
| p4 | L | 28.3 | 32.5 | 30.7 | 26.4 | 29.9 | 31.2 | 29.1 | 22.8 | 28.3 | - | 34 | 36.1 | 34.5 | 30.5 | 34.3 | 34.4 |
| W | 15.1 | 16.8 | 17.1 | 17.6 | 16.4 | 16.4 | 18.6 | 14.5est | 12.6 | 16.2 | - | 19 | 20.7 | 19.4 | 17.5 | 18.4 | 18.6 |

Suborder FELIFORMIA Kreftoi, 1945

*Family PERCROCUTIDAE Werdelin & Solounias, 1991*

*Genus Dinocrocuta* Schmidt-Kittler, 1976

**Type species. — Dinocrocuta algeriensis** (Lydekker, 1884) by original designation.

**Dinocrocuta senyureki** (Ozansoy, 1957)

(Figs 5, 6; Tables 4, 5)

*Machairodus anaphusius* – Sayar 1953: fig. 1.

**Referred Material from Küçükçekmece.** — MNHN.F.TRQ685, fragment of left hemimandible with p2-3; KÇ 58, right p4; KÇ 60, fragment of right maxilla with P2; TRQ948, proximal half of left ulna, lacking most of the olecranon.
DESCRIPTION

Mandible (Fig. 5A, B; Table 6)

Only an anterior fragment of the dentary is preserved, but it is thick (TMp3 = 23 mm) and robust. The post-canine diastema is long and there is no alveolus for a p1.

Dentition

Lower dentition (Fig. 5A-D; Table 6). The two premolars preserved in MNHN.F.TRQ685 display a moderate, horizontal wear pattern, the p2 being less heavily worn than the p3. The p2 is set slightly obliquely in the dentary and relative to the p3 (see Fig. 5A). A major part of the mesial root is visible well above the dorsal rim of the dentary so that in lateral view the tooth seems to be oriented backwards. It bears a strong, but not particularly bulbous, main cusp; the crown width increases distad; the mesial accessory cusp is small, slightly lingual, and displays a small wear facet; the distal accessory cusp is slightly more prominent than
the mesial one, centrally located, and is followed by a short cingulid. The p3 is both worn and damaged so that it is not possible to assess the relative development of the accessory cusps. However, the tooth does not show the bulbous morphology of the p3 of durophagous species such as *Adcrocuta* spp. On the contrary, p3 appears to be an enlarged version of the p2. The isolated p4 KÇ 58 is moderately worn. It differs from the p2 and p3 by a more slender main cusp and more developed accessory cusps, where the mesial cusp is larger than the distal cusp. The distal accessory cusp is followed by a short cingulid. The distal rim of the tooth is curved distally but rectilinear more mesially along the contact with the carnassial (see Fig. 5D).

**Upper dentition** (Fig. 5E; F; Table 7). The fragmentary right maxilla KÇ 60 preserves the P2. Only the alveoli of the I3, canine, and P1 are preserved. That of the I3 is not complete but indicates a tooth larger than the P1. The canine alveolus is oval, approximately 32 mm in length and 25 mm in width. The single, rounded alveolus of P1 indicates that it was relatively large (alveolus length is 13.9 mm, alveolus width is 12 mm). Very short diastemata separate the P1 from the adjacent teeth. The main cusp and distal accessory cusp of P2 display a moderate, horizontal wear pattern. The tooth is wide relative to its length; it has roughly the same width mesial to the main cusp as distal to that cusp. There is no mesial accessory cusp but a strong cingulum that is particularly prominent mesiolingually. Contrary to the p2, the distal accessory cusp of P2 is lingually located; the distal cingulum is very reduced.

**Postcranium** (Fig. 6)

A fragmentary ulna is the only postcranial bone from Küçükçekmece that might be assigned to *D. senyureki*. Unfortunately, the olecranon is not preserved. Overall the shaft is slender and the articular part is narrow compared to that of *Indarctos* and *Machairodus*, two genera also present at the site. On the anconeal process, the articular surface for the humerus extends proximally less than in the bears, felids, and hyaenids used in comparison (*Ursus* sp., *Indarctos arctoides*, *Panthera tigris* (Linnaeus, 1758) and *P. leo* (Linnaeus, 1758), *Machairodus aphanistus*, *Amphimachairodus giganteus* (Wagner, 1848), *Crocuta crocuta* (Erxleben, 1777), *Hyaena hyaena* (Linnaeus, 1758)), especially on the lateral side. The morphology of the radial notch is typical of that in hyaenids: the lateral extremity of the coronoid process is very short and poorly projected, the articular facet for the articular circumference of the radius forms a very thin surface, and a deep, marked area (presumably for ligament attachment at the proximal radioulnar joint) is present just distal to the radial notch. Overall MNHN.F.ETRQ948 looks very like the ulna of roughly contemporaneous hyaenids such as *Adcrocuta eximia* (e.g., MNHN.F.PIK3247, proximal fragment of right ulna from Pikermi, late Miocene of Greece) and that of extant hyaenids (*Crocuta crocuta*, *Hyaena hyaena*) though the shaft of the fossil specimen is clearly more robust than in the extant taxa.

**Comparisons and Discussion**

We follow previous authors by recognizing the family Percrocutidae as distinct from the Hyaenidae Gray, 1821 (see Werdelin 1996, for a historical background). Here I restrict comparisons to the late Miocene middle and large-sized percrocutids, i.e. the species of the genus *Dinocrocuta*. Sayar (1953: fig. 1) figured KÇ 60 as a maxilla fragment of the sabre-toothed felid *Machairodus aphanistus*, but the premolar preserved and the size of the alveoli indicate a clear distinction from those of a sabre-toothed cat. This specimen (KÇ 60, Fig. 5E, F) is assigned to *Dinocrocuta senyureki* based on the overall size of the dentition, the morphology of P2, with its distinctive mesial cingulum, and the presence at the site of additional specimens of the same species. *Dinocrocuta senyureki* was erected by Ozansoy (1957) and described in detail later (Ozansoy 1961, 1965) based on specimens from Yassiören (MN9, late Miocene, Turkey). The syntype content is not clear in 1957 but is detailed in 1961. Some of the specimens listed by Ozansoy (1961) are stored in the MNHN and comprise: MNHN.F.ETRQ1010 (= Yas 62 in Howell & Petter 1985; Ozansoy 1957: pl. 2; Ozansoy 1961: pl. 2, figs 3, 4), a fragment of left hemimandible with p2, fragmentary p3, p4-m1; TRQ1009 (= Yas 59 in Howell & Petter 1985; Ozansoy 1961: figs 4, 5, pl. 2, figs 1, 2; Ozansoy 1965: pl. 3, figs 3, 4), a fragment of right mandible with c-m1; TRQ1008 (= Yas 60 in Howell & Petter 1985; Ozansoy 1961: figs 2, 3, pl. 1, figs 1-3; Ozansoy 1965: pl. 3, figs 1, 2), a fragment of left maxilla with P2-M1; and TRQ1007 (= Yas 61 in Howell & Petter 1985), a fragment of right maxilla with P3-4 belonging to the same individual; a few additional, more fragmentary specimens (see Ozansoy 1961, 1965). In his publications Ozansoy did not clearly

| TABLE 7. — Measurements (in mm) of Dinocrocuta senyureki (Ozansoy, 1957) from Küçükçekmece compared with other Percrocutidae: upper dentition. Symbols: *`, type specimen; 1, from Viranta & Werdelin (2003); 2, from Howell (1987); 3, from Zhang & Xue (1996). Abbreviation: Küçük, Küçükçekmece; `, mean. Specimens labelled `AS` and `S` are stored in the MACA. See Material and methods for additional abbreviations. |
| **Dinocrocuta senyureki** | **D. algeriensis** (Arambourg, 1959) | **D. gigantea** (Schlösser, 1903) |
| Küçük | Yassiören | Sahabi | Bou Hanifa | Fugu |
| KÇ 60 | MNHN.F. TRQ1007 | AS.95.413*1 | 1P22A2 | MNHN.F-1951. 9-174* |
| P2 L | 31 | 26.3 | 26.3 | 26.2 | 24 | 29.7 |
| P2 W | 17.9 | – | 16 | 15.6 | 16.3 | 20.5 |
select a type specimen, however. Howell & Petter (1985) regarded TRQ1010 (the only specimen figured by Ozansoy in 1957) as the type specimen of *Dinocrocuta senyureki*. This specimen is a lectotype, by subsequent designation (Howell & Petter 1985). The material from Küçükçekmece is fragmentary, but the assignment of this material to *Dinocrocuta senyureki* is well supported by the comparison with specimens from the type locality. I did not find any difference between the lectotype TRQ1010 (Yassiören) and TRQ695 (Küçükçekmece). Both specimens share the absence of p1, the oblique orientation on the dentary and the morphology of p2, the absence of marked bulbous morphology on p3. In the upper dentition, the distinct mesiolingual cingulum around the crown basis of P2 has the same development in TRQ1007 from Yassiören and KC 60 from Küçükçekmece. This is also true for the p4 KC 58 from the latter site, which shows cusps and cingulum as developed as in the p4 of the specimens from Yassiören listed above. Additional specimens from the Sinap were collected more recently and described by Viranta & Werdelin (2003). This sample comes from Loc. 108 (10 Ma in age; Kappelman et al. 2003) and Loc. 12 (9.6 Ma in age; Kappelman et al. 2003), both in the MN9 (early Vallesian) biostratigraphic level and from Loc. 37, MN10 (late Vallesian). These localities yielded a few postcranial bones and many dental remains (Tables 6, 7). Among this new sample from Yassiören the elements that also are known from Küçükçekmece are morphologically very similar. In addition to the type locality, *D. senyureki* has been described from the Turkish sites of Eşme Akçaköy (MN9, early Vallesian), Kayadibi (MN11, early Turolian) and İnönü (MN10-11, late Vallesian-early Turolian), which yielded dental elements that are not comparable with those from Küçükçekmece (Schmidt-Kittler 1976). Elsewhere, the species is also known at Sahabi (late Miocene, Libya) from right and left hemimandibles of a single individual, an isolated P2 (Howell 1987: fig. 4), and several postcranial specimens. There are differences in proportions or size of teeth or between teeth (Table 6), but the intraspecific variability of the sample from Yassiören alone indicates great variability in size of *D. senyureki*. The P2 from Küçükçekmece is larger than in the other specimens of the species, but this is the sole difference and the known sample is limited. Therefore the material from Küçükçekmece is assigned to the same species.

Other species of *Dinocrocuta* are known from late Miocene sites in the Old World, especially *D. minor* (Ozanay, 1965), *D. salonicae* (Andrews, 1918), although generic assignment of this species is still debated (Koufous 1995; Zhang 2005), *D. gigantea* (Schlosser, 1903) and *D. algeriensis* (Arambourg, 1959). The morphological distinction between the species of *Dinocrocuta*, which has been discussed elsewhere (e.g., Howell & Petter 1985; Spassov & Koufous 2002; Zhang 2005), is not easy. The main reason to assign the material from Küçükçekmece to *D. senyureki* rather than to *D. minor* is the size, with *D. minor* being much smaller based on the holotype (by monotypy) and probably single known specimen of this species (but see Viranta & Werdelin 2003: 182),

![Figure 6](image)

**Fig. 6.** — *Dinocrocuta senyureki* (Ozanay, 1957), postcranium: MNHN.F.TRQ948, fragment of left humerus with i1-m1 = Yas 58 in Howell & Petter 1985; Ozanay 1965: pl. 4, fig. 1). The p2 of the holotype of *D. minor* is narrower distally than in *D. senyureki*, but it is hard to tell whether this difference is significant considering the limited samples. Except size, one of the diagnostic features of *D. senyureki* is the presence on P3 of a strong mesial accessory cusp, but this tooth is not preserved in the material from Küçükçekmece. According to Zhang (2005), compared to *D. senyureki*, *D. gigantea* is much larger and has proportionally larger p2/P2. The specimens from Küçükçekmece fit this picture and show a more reduced p2 compared to p3 than in most specimens of *D. gigantea*. *Dinocrocuta algeriensis* is based on a sample from Oued el Hamman (= Bou Hanïfa; late Miocene, Algeria; Arambourg 1959: fig. 8A, 9D, 10C, 11, 12D, pl. 2, pl. 3, fig. 1-4) representing at least three individuals, two (young) adults (the holotype MNHN.F.1951.9-174, the paratype MNHN.F.1951.9-172, MNHN.F.1951.9-29, MNHN.F.1951.9-75, MNHN.F.1951.9-76) and one juvenile (MNHN.F.1951.9-19 and a couple of isolated, unnumbered teeth). An isolated P3 (MNHN.F.FAMA9) from Menacer (= Marceau in Arambourg 1959) is also assigned to this species. Like *D. gigantea*, *Dinocrocuta algeriensis* differs from our material by a enlarged p2, especially relative to p3, and a thicker P2.

**MNHN.F.TRQ948** is an important specimen because percrocud postcranial remains are rare (Howell 1987; Zhang & Xue 1996; Viranta & Werdelin 2003). Nevertheless, it is far too fragmentary to address morphological distinction between the skeleton of hyaenids and percrocuts.
**Table 8.** Measurements (in mm) of cf. *Thalassictis* sp. from Küçükçekmece compared with other species of *Thalassictis* Gervais, 1850 ex Nordmann MS. Symbols: *, type specimen; **, type specimen of *T. chinjiensis* (Pilgrim, 1932), junior synonym of *T. proava* (Pilgrim, 1910); m, mean; t, from Kürten (1982); t, from Morlo (1997); t, from Beaumont (1988); t, from Villalta & Crusafont (1943); t, from Crusafont & Petter (1969); t, from Viranta & Werdelin (2003); t, from Heizmann & Kubiak (1992); t, from Schmidt-Kittler (1976); t, from Mayda et al. (2015); t, from Semenov (1989); t, from Bonis (2005); t, from Viet (1951); t, from Pilgrim (1932). Abbreviations: Küçük, Küçükçekmece; Host, Hostalets de Pierola; S. Q., San Quirze; Prz2, Przeworno 2; Yeni Esk., Yeni Eskihisar; Akk., Akkasdağ; LGSA, La Grive Saint-Alban. Specimens labeled ‘AS’ and ‘S’ are stored in the MACA. See Material and methods for additional abbreviations.

| cf. *Thalassictis* sp. (Pilgrim, 1932) | T. montadai (Villalta & Crusafont, 1943) |
|--------------------------------------|---------------------------------------|
| Küçük. | Host.* |
| Kishinev** | S. Q.** |
| DSM DD 3406 | Sinap** |
| IPS-2074 | Prz2*** |
| AS92.463 & 464** | Yeni Esk.** |
| MF/1992/91 | 722** |
| **m1** | **W** | **TLim1** | **TLam1** |
| Küçük. | Küçük. | Küçük. | Küçük. |
| L | 22.10 | 17.4 | 16 | 20.5 |
| W | 10.40 | 7.98 | 7 | 9 |
| TLam1 | 18.20 | 13 | – | – |
| TLam1 | 17.60 | – | – | – |

Family *Hyænidae* Gray, 1821

**Genus *Thalassictis* Gervais, 1850 ex Nordmann MS

*Type species.* — *Thalassictis robusta* Gervais, 1850 ex Nordmann MS by subsequent designation of Palmer (1904).

| cf. *Thalassictis* sp. (Fig. 7A-C; Table 8) |
|-------------------------------------------|
| Ictitherium sp. — Malik & Nafiz 1933: 67, pl. 12, fig. 5. — Yalçınlar 1954: 140. — Özansoy 1957: 33. Uncertain synonymy. |

**Comparisons and Discussion**

The Hyænidae is one of the most diverse carnivores in Europe during the Miocene. This family experienced a diversification and geographic expansion during the late Miocene (Vallesian and early Turolian), before decreasing in diversity toward the end of the Turolian (Werdelin & Solounias 1991, 1996). Morphologically (reduced metacoonid and talonid, medium size), the carnassial from Küçükçekmece resembles that of species assigned to genera that are classified in the third ecomorph proposed by Werdelin & Solounias (1996), comprising *Ictitherium* Wagner, 1848, *Thalassictis*, *Hyænotherium* Semenov, 1989 and *Pallinsyena* Qiu, Huang & Guo, 1979 also belong to this ecomorph. The definition and specific content of these taxa have known many changes in the past (Werdelin & Solounias 1991, 1996) and even recent authors do not always agree regarding their taxonomy (compare, e.g., Viranta & Werdelin 2003; Bonis 2004, 2005; Tseng & Wang 2007; Özkurt et al. 2015). It is beyond the scope of this paper to discuss this topic. In the context of this study, I have first considered the type species of each of these genera. Among
Fig. 7. — A-C, cf. Thalassictis sp.: Kadi Mezarligi Quarry unnumbered, right m1 in labial (A), occlusal (B), and lingual (C) views; D-N, Machairodus aphanistus (Kaup, 1832): MNHN.F.TRQ1214, right p4 in occlusal (D) and labial (E) views; TRQ1213, right m1 in labial (F) and occlusal (G) views; TRQ1215, right P4 in occlusal (H), lingual (I), and labial (J) views; TRQ094, fragment of right Mt III in proximal (K) and anterior (L) views; TRQ700, proximal fragment of proximal phalanx in proximal (M) and anterior (N) views. Scale bars: 10 mm.
Table 9. — Measurements (in mm) of Machairodus aphanistus (Kaup, 1832) from Küçükçekmece compared with specimens from European localities. Lower dentition. Abbreviations: Höw., Höwenengg; Char., Charoailles; Zill., Zillingdorf; LFV, Los Valles de Fuenteduenas; Sob., Soblay; Kemik., Kemikitepe; DD, Dorn-Dörkheim; Mah., Mahmutgazi; nn, unnumbered. Symbols: *: type species; †: mean; ††: from Beaumont (1988); ‡: from Mornescolli et al. (2014); §: from Spassov & Koufos (2002); ‡‡: from Madurell-Malapeira et al. (2014); ‡‡‡: from Bonis (1994); ‡‡‡‡: from Beaumont (1986); ‡‡‡‡‡: from Moro (1997); ‡‡‡‡‡‡: from Schmidt-Kittler (1976). See Material and methods for additional abbreviations. Specimens TRQ are from MNHN.F Collection.

| Küçükçekmece | TRQ | Höw. (cf.) | Char. | Zill. | LFV |
|--------------|-----|-----------|-------|-------|-----|
| TRQ          | 1213| 1214      |       |       |     |
| HöM-Din      | 1132| BMNH 49967c |       |       |     |
| FFS H6 141   |     | NMB Cm 244 |       |       |     |
| NHCW         |     | MNCN 32000 | MNCN 46552 |     |     |

Table 10. — Measurements (in mm) of Machairodus aphanistus (Kaup, 1832) from Küçükçekmece compared with specimens from European localities. Upper dentition. Symbols: *: mean; †: from Beaumont (1988); ‡: from Mornescolli et al. (2014); §: from Madurell-Malapeira et al. (2014); ‡‡: from Schmidt-Kittler (1976). See Material and methods for additional abbreviations.

| Küçükçekmece | Montredon (cf.) | Batallones1 | Nessebar3 | Vallées-Penedès (IPS-3)4 | Kemik.5 | DD (cf.)6 | Mah.8 |
|--------------|----------------|-------------|-----------|--------------------------|--------|--------|------|
| TRQ          | 1213 | 1214       |           |                          |        |        |      |
| nn           |       |            |           |                          |        |        |      |
| FSL 210.390 | MTN 3173 | TF 164     | Bat-1m6  | Bat-3m8                  |        |        |      |
| NMNH FM 1505 |       |            |           |                          |        |        |      |
| 6208313167   | 13177 | 13165      | KTD 63   | Ma 149                   |        |        |      |
| 14/9         |        |            |          |                          |        |        |      |

them only *Hyaterotherium wongii* (Zdansky, 1924) (type species of *Hyaterotherium* = *H. magnum* Semenov, 1989), *Palinhyena reperta* Qi, Huang & Guo, 1979 (type species of *Palinhyena*), *Hyaenictitherium hyanaeides* (Zdansky, 1924) (type species of *Hyaenictitherium* and *Ictitherium vivirrottin* Roth and Wagner, 1854 (type species of *Ictitherium*) were included in Werdelin & Solounias (1991) cladistic analysis. The character analysis performed by these authors includes only two characters applicable to the tooth from Küçükçekmece: the number of talonid cusps (character 7 in Werdelin & Solounias 1991: 51) and the presence/absence of the metacodon (character 8 in Werdelin & Solounias 1991: 51). The latter is not informative as the metacodon is present in all the species considered here and in the tooth from Küçükçekmece. The number of talonid cusps is more diagnostic than the latter species has only two cusps in the talonid, the hypoconid and the entoconid; the hypoconulid is absent/vestigial. All the type species listed above retain the primitive feature, i.e. three cusps in the talonid of m1 (see also Semenov 2008: fig. 6; analysis of Tseng & Wang 2007: Appendix 2, character 6). However two genera were not included in the cladistic analysis of Werdelin & Solounias (1991): *Miohyaenotherium* and *Thalassictis*. These authors placed the species of these genera in a clade comprising *Hyaterotherium*, *Hyaenictitherium* and more derived genera (e.g., hunting hyaenas and bone-cracking taxa; Werdelin & Solounias 1991: fig. 38), considering, however, that the type and only species of *Miohyaenotherium*, *M. besarabicum* Semenov, 1989, is a possible synonym of *Hyaenictitherium parvum* (Khomenko, 1914). In a recent analysis, Tseng & Wang (2007) considered the two latter species as synonyms of *H. wongii*. The close relationship of *M. besarabicum* with *Hyaenictitherium* spp. and/or *Hyaterotherium wongii* suggest that it is distinct from the species from Küçükçekmece. The genus *Thalassictis* includes the type species *Thalassictis robusta* Gervais, 1850 ex Nordmann MS and according to Werdelin & Solounias (1991) perhaps also: *T. certa* (Major, 1903), *T. sarmatica* (Pavlov, 1908), *T. proca* (Pilgrim, 1910) (= *T. chingiensis* Pilgrim, 1932); see Werdelin & Solounias 1991: 35, *T. montiadae* (Villalta & Crusafont, 1943) and *T. spelea* (Semenov, 1988). *Thalassictis sarmatica* is based on a skull and not comparable to the material from Küçükçekmece. The m1 of the species of *Thalassictis* is described as having a protoconid taller than the paracodon, a reduced metaconid, and a short and low talonid with two or three cusps. Generally, late Orellanian-Astaracian
 FAMILY Felidae Fischer, 1817

Genus Machairodus Kaup, 1833

**Type species.** — Machairodus aphanistus (Kaup, 1832) by subsequent designation of Pilgrim (1931). Matthew (1929: 500) supposed that M. aphanistus was "probably" the type species of the genus, but this cannot be considered as a clear designation.

**Machairodus aphanistus** (Kaup, 1832)  
(Figs 7D-N, 8; Tables 9, 10, 11)

**Referred material from Küçükçekmece.** — Çukurçesme Quarry unnumbered, fragment of right m1; IU 01, distal half of a left humerus; MNHN.FTRQ700, proximal fragment of proximal phalanx; TRQ694, fragment of right Mt III; TRQ1213, right m1; TRQ1214, right p4; TRQ1215, right P4. The two last specimens present the same colour and wear pattern and might belong to the same individual.

(MN5-8) specimens have an m1 talonid with three cusps (Villalta & Crusafont 1943; Viret 1951; Crusafont & Petter 1969; Schmidt-Kittler 1976; Kurtén 1982; Heizmann & Kubiak 1992; Mayda et al. 2015) and Vallesian and Turolian specimens (i.e. MN9-12) have only two cusps (Viranta & Werdelin 2003; Bonis 2005). The only exceptions are late Miocene specimens from the Turolian of Dorn-Dürkheim (T. robusta; Morlo 1997) and from Chinji (T. proava; Pilgrim 1932; for age, see Werdelin & Solounias 1991) that have a three-cusped m1 talonid. In addition, intra-specific morphological variability of the relative development of talonid cusps is observed in some species. For example, in Thalassictis montadai the m1 may have a tall hypoconulid associated with a tall entoconid (specimens from Spain and Poland; Villalta & Crusafont 1943; Heizmann & Kubiak 1992) or an entoconid smaller than the hypoconid, as in specimens from the Sinap (Viranta & Werdelin 2003).

The m1 from Küçükçekmece resembles Thalassictis species in having a protoconid taller than the paraconid, a reduced metaconid, and a short and low talonid with two cusps. In fact in the number and relative development of the talonid cusps, it differs from *T. proava* and *T. certa* and resembles late Miocene specimens assigned to *T. montadai* and *T. spelea*. The m1 from Turkey differs from species of *Thalassictis* in having a longer protoconid relative to the protoconid (measured parallel to the alveolar margin) and a shorter talonid. Pending discovery of more material, I maintain the taxonomic assignment open.

Malik & Nafiz (1933: pl. 12, fig. 5) assigned to Ictitherium sp. an incisor and a p4 (L: 19 mm; w: 11 mm) that could belong to the same species. This is reported in the published faunal lists of Küçükçekmece (e.g., Yalçınlar 1954; Ozansoy 1957). These specimens were destroyed by fire during the last century. Nicolas (1978) also listed Ictitherium sp. cf. I. orbignyi, which is now Plionviserrops orbignyi, but this species is clearly distinct from cf. *Thalassictis* sp. described here. In Nicolas’ collection stored in the MNHN, there is no evidence supporting the presence of *P. orbignyi* or a closely related species.
### Table 11

Measurements (in mm) of *Machairodus aphanistus* from Kükükçekeke compared with specimens from European localities. Postcranium. Abbreviations: Kükük, Kükükçekeke; Ph, phalax; Hum, humerus; Dg., digit; epi, epiphysis; art, distal articulation; prox, proximal; dist, distal; ML, mediolateral; AP, anteroposterior; T, thickness; i, from Madurell-Malapeira et al. (2014); j, from Beaumont (1998); k, from Salesa et al. (2012b); l, from Roussiaakis (2002). Material labelled ‘PIK’ and ‘MAR’ are from the MNHN. See Material and methods for additional abbreviations.

| Kükük. | Vallès-Penedès (IPS) | Montredon² |
|--------|----------------------|------------|
| MNHN.F. | TRQ700 | 36058 | 15007 | 15015 | 15021 | 15022 | 13173 |
| Ph prox ML W | 21.5 | 18.7 | 19.2 | 20.6 | 20.4 | 17.8 | – |
| Ph prox AP T | 17 | 14.7 | 12.8 | 13.9 | 13.9 | 12.9 | – |
| Hum dist epi ML W | 88.3 | – | – | – | – | – | 77est |
| Hum dist art ML W | 58.6 | – | – | – | – | – | – |
| Ml III prox ML W | 25.4 | – | – | – | – | – | 25.7 |
| – | – | – | – | – | – | – | 22.5est |

### Table 12

Measurements (in mm) of *Pristifelis* sp. cf. *P. attica* from Kükükçekeke compared with late Miocene small felines from Europe. Symbols: *, type material; **, lectotype of *Pseudaelurus* transitorius Depéret, 1892. Abbreviations: Kükük, Kükükçekeke; 1, from Beaumont (1961); 2, from Roussiaakis (2002); 3, from Salesa et al. (2012b); 4, from Salesa et al. (2012a); 5, from Viranta & Werdelin (2003). See Material and methods for additional abbreviations.

| Pristifelis sp. | Pristifelis attica (Wagner, 1857) | Styriofelis vallesiensis Salesa, Antón, Morales & Peigné, 2012 | Styriofelis turnauensis (Hoernes, 1882) |
|----------------|---------------------------------|---------------------------------|---------------------------------|
| Kükük. | Pikermi | Las Casiones⁢ | Battalones (BAT-B)⁴ | La Grive (MHN-LGr & BSP) | Sinap |
| MNHN.F. | AMPG PG | AMPG PG | AMPG PG | MGL 103 | D6-65 | 2074 | 3319 | 57 | 65 | 1937 | 1937-13336 | S.BSP |
| K61 | 110¹ | 01/10²/10³ | mean | 103 | 102 | 101 | 65 | 45 | left | 1382 | 1387 | 13328 |
| p3 L | 6.3 | 7.1 | 7.1 | 7.05 | 6.52 | 6.74 | 6.02 | 6.26 | 6.48 | 6.19 | 6.5 | 6.9 | 7.2 | 7 | 6.7 |
| W | 3.2 | 4.1 | 3.4 | 3.52 | 4 | 2.87 | 3.16 | 2.8 | 2.82 | 3.03 | 3.02 | 3.2 | 3.3 | 3.3 | 3.5 | 3.8 |
| H | 4.3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| p4 L | 8.2 | 9.2 | 8.3 | 9.37 | 9.8 | 7.63 | 8.46 | 7.37 | 7.36 | 7.91 | 7.69 | 8.8 | 8.6 | 8.6 | 9 | – | 9.2 |
| W | 3.9 | 4.2 | 3.8 | 4est | 3.98 | 4.2 | 3.66 | 3.85 | 3.22 | 3.44 | 3.58 | 4.4 | 4.1 | 4.3 | 4 | – | – |
| H | 5.3 | – | – | – | – | – | – | – | – | – | – | 5.8 | 5.8 | 6.1 | – | – | – |
| m1 L | 9.3 | 11 | 10.2 | 10.3 | 10.3 | 11.1 | 9.39 | 10.48 | 9.41 | 9.28 | 9.38 | 9.46 | 11 | 10.51 | 11.4 | 11.2 | 11.9 |
| H | 3.9 | 5 | 4.3 | 4.3 | 4.43 | 4.4 | 3.94 | 4.12 | 3.94 | 3.39 | 3.93 | 4.06 | 4.9 | 4.9 | 5 | 4.7 | 4.8 | 4.8 |
| HPrm1 | 5.3 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |
| DMp4-m1 | 13 | 12.4 | 12.8 | – | – | – | – | – | – | – | – | – | – | – | – | – | – | – |

### Postcranial

Three postcranial specimens are assigned to *M. aphanistus*. IU 01 is a fragment of left humerus broken across the mid-diaphysis (Fig. 8). The shaft and the olecranon fossa are also damaged. The maximum width of the distal epiphysis is 88.3 mm and the maximum width of the articulation is 58.6 mm. The anteroposterior diameter of the medial part is 44.4 mm, while that of the lateral part is 49.5 mm. The overall morphology of this specimen is similar to that of specimens assigned to *Amphimachairodus giganteus* (Wagner, 1848) from Maragheh (MN11, Iran) and Pikermi that were used in comparison (MNHN.EPIK3358 and PIK3361, MNHN.EMAR3410 and specimens figured in Roussiaakis 2002) and to that of published material related to *M. aphanistus* from the Vallès-Penedès Basin (Madurell-Malapeira et al. 2014) and Montredon (Beaumont 1988; pl. 4, fig. 10). Our specimen is a little bit more robust, especially compared to the specimen from Pikermi figured by Roussiaakis (2002; fig. 12-1). The medial epicondyle is medi ally and proximodistally more extended than in the specimen from Montredon (*M. cf. aphanistus*), but not especially more than in the compared specimens of *A. giganteus* that display great morphological variability regarding this feature.
MNHN.F.TEQ700 (Fig. 7M, N) is a proximal fragment of a proximal phalanx with a proximal mediolateral width of 21.5 mm and a proximal dorsoventral height of 17 mm. The phalanx is robust, with a dorsoventrally compressed shaft and a slightly asymmetrical proximal articulation. It is very similar to the proximal phalanges of the associated forelimb of *A. giganteus* MHNN.EPIK3241 from Pikermi (see Table 11). The fragmentary Mt III (Fig. 7K, L) lacks the distal epiphysis and the ventral part of the proximal articular surface. The proximal width of the head is 25.4 mm. The fragment is approximately 110 mm long. In lateral view the diaphysis is curved dorsally.

**Comparisons and Discussion**

*Macbairdus aphanistus* is a relatively common Vallesian-early Turolian (MN9-MN11) species of Europe, where it is known from a number of localities in Germany, Spain, France, Austria, Switzerland, Bulgaria, Hungary and Turkey (see Madurell-Malapeira et al. 2014). In Turkey, remains of the species are rare, however, and is known only from Kemiklитеpe D (MN11) and Mahmutgazi (MN11). The dental material described here represents at least 3 individuals: two are represented by the m1 (MNHN.F.TEQ1213 and Çukurcesme unnumbered), and the third individual is documented by TRQ1214, a p4, and TRQ1215, a P4. The two first individuals are rather small and about the size of early Vallesian (MN9) specimens such as those from Los Valles de Fuentidueña (including specimens assigned to *M. alberdiae* Ginsburg et al. 1981, a junior synonym of *M. aphanistus*; see Peigné et al. 2005), Höwenegg, and Can Llobateres (Table 9). The third individual is of average size for the species, with dental lengths within the range of populations such as that from Batallones (MN10, Spain; Monescillo et al. 2014; Tables 9, 10). I consider that the material from Küçükçekmece belongs to a single species displaying a large size variability that could be related to sexual dimorphism. *Macbairdus aphanistus* was one of the most dimorphic known felids, together with the extant *Panthera leo* (Linnaeus, 1758) and *Panthera pardus* (Linnaeus, 1758) (Monescillo et al. 2014). Morphologically, the material from Küçükçekmece does not differ from that of the other sites where the species is known, especially the large sample from Batallones (Antón et al. 2004; Monescillo et al. 2014).

The fragmentary postcranial remains belong to different individuals also. The measurements of the humerus are within the range of those of the humerus of extant *P. leo* and *P. tigris* (Peigné et al. 2005; table 2), of *Amphimachairodus giganteus* from Pikermi and Maragheh (Table 11), and of *M. aphanistus* from Montredon and the Vallés-Penedès Basin. The mediolateral width of the proximal articulation of the Mt III and the size and proportions of the proximal phalanges are within the size range of specimens of *Macbairdus aphanistus* and *Amphimachairodus giganteus* (Table 11). Specimens MNHN.F.PIK3278, PIK3279, PIK3280, PIK3240 and PIK3244 from Pikermi, described as metatarsals by Öz Kurt et al. (2015), are all metacarpals and therefore not comparable to the material from Küçükçekmece.

Genus *Pristifelis* Salesa, Antón, Morales & Peigné, 2012

**Type Species.** — *Pristifelis attica* (Wagner, 1857) by original designation.

*Pristifelis* sp. cf. *P. attica* (Wagner, 1857) (Fig. 9A, B; Table 12)

**Referred Material from Küçükçekmece.** — KÇ 61, right hemimandible with p2-m1.

**Description**

**Mandible** (Fig. 9A, B; Table 12)

There is no premolar between the canine and p3. The p3 is short and low compared to p4. It has no mesial cusp and a small distal accessory cuspid. The distal cingulid is long and extended lingually and labially. The tooth is much wider distally than mesially. There is a tiny diastema between p3 and p4. The p4 is taller than the m1 paracoonid and of the same height as the m1 protoconid. The main cuspid has a straight mesial rim and a markedly convex distal rim. Accessory cuspids are large and similar in size. The distal accessory cuspid is located labially in the crown. It is separated from the main cuspid by a deep notch and its distal rim is vertical. The distal cingulid is more expanded than in p3. The carnassial is elongated and low compared to p4. Its paracoonid is lower than the protoconid and approximately of the same length. The blade of these two cuspids forms an obtuse angle in labial view. The distal face of the protoconid is vertical. The talonid is short and the metaconid is not individualized.

**Comparisons and Discussion**

Late Miocene small-sized Felinae are not abundant in Europe. Two species are recognized in MN10-MN13 strata: *Styriofelis vallesiensis* from Batallones-1, Batallones-3 (type locality) in Spain and Maragheh in Iran, and *Pristifelis attica* from Pikermi (type locality), Samos, and, possibly, Vathyllakkos-3 in Greece, Akkasdağ in Turkey and Las Casiones in Spain (Roussias 2002; Bonis 2005; Salesa et al. 2012a, b). Additional late Miocene similar-sized felines are Felinae indet. from Las Casiones (Salesa et al. 2012b) and the feline from Dorn-Dürkheim assigned to *P. attica* by Morlo (1997) but showing a distinct metacoonid suggesting a different species (according to Roussias 2002: 714), such as *S. vallesiensis*.

The derived characters that support the assignment of the hemimandible from Küçükçekmece to *Pristifelis* sp. cf. *P. attica* are the absence of premolars anterior to p3 and a distally wide p3 lacking a mesial cuspid. The first character distinguishes the specimen from Küçükçekmece from *Styriofelis vallesiensis* (and...
from the other species assigned to *Styriofelis*. The development of the mesial cusp on the p3 is highly variable, especially in *P. attica* (Roussaki 2002; Salesa et al. 2012b), but in KÇ 61 this tooth lacks a mesial cusp and is wider distally than in the contemporaneous *S. vallesiensis*. The Turkish specimen differs from the Turolian *P. attica* (i.e. specimens included in the comparison: see Table 12) in having a less reduced talonid and in being smaller in size; it is, however, from a site that is several million years older.

**Felidae gen. et sp. indet., medium size (Fig. 9C, D; Table 13)**

**Refereed material from Küçükçekmece.** — MNHN.F.TRQ701, proximal phalanx.

**Description**

The phalanx (Fig. 9C, D) is relatively long (Table 13). It is relatively slender with a dorsoventrally compressed proximal articulation and a distal epiphysis that is narrower than the proximal one (Table 13).

**Comparisons and Discussion**

The length of **MNHN.F.TRQ701** is much greater than the proximal phalanges of the known small felines from the late Miocene of Europe. On the other hand this phalanx fits with the size range of the proximal phalanges of species such as *Promeganteron oggygia* (Salesa 2002) or *Metailurus parvulus* (Hensel, 1862) (Roussaki *et al.* 2006; for a discussion of the taxonomic status of this species, see also Spassov & Geraads 2015), although not for all measurements. In previous faunal lists of Küçükçekmece, *Paramachairodus orientalis* (Kittl, 1887), or *Machairodus orientalis* Kittl, 1887, was mentioned by Malik & Nafiz (1933) and Yalçınlar (1954) and *Machairodus (Paramachairodus) orientalis* by Özanşoy (1957). One of the specimens assigned to this species was figured by Malik & Nafiz (1933: pl. 12, fig. 7); the only descriptive information is the length of P3 (12 mm) and of the diastema between the canine and P3 (5 mm). Unfortunately this specimen was not recovered and was certainly destroyed by fire (see Sen 2016).

**MNHN.F.TRQ701** described here and the specimen figured by Malik & Nafiz (see above) both support the presence of a third, medium-sized felid at Küçükçekmece. Both the size and the morphology of this felid exclude an assignment to either *Machairodus aphanistus* or *Pristifelis* sp. cf. *P. attica* already identified from the site. In contrast, the size of the phalanx TRQ701 and/or that of the P3 figured by Malik & Nafiz (1933) fits well with that of the same elements in late Miocene felids such as *Paramachairodus orientalis*, *Promeganteron oggygia*, *Metailurus parvulus* and *Felis panmirii* Özansoy, 1965 from Yassıören. Compared to these species, however, the P3 of the specimen figured by Malik & Nafiz (1933) is taller relative to its length. The phalanx is not diagnostic at the genus level.

**Discussion**

The 1942 fire at the Geological Institute of Istanbul University destroyed most of the fossil specimens described by Malik & Nafiz (1933). Among Carnivora, this occurred for specimens assigned to *Mustela pentelici* and a (more or less important) part of the material assigned to the Phocidae, *Indarctos arctoides*, cf. *Thalassictis* sp. and Felidae gen. et sp. indet. medium size.

Nevertheless my study of the few specimens still stored at the ITU and IU and at the MNHN allows identification of 9 taxa of Carnivora at Küçükçekmece: the ursid *Sivaonyx hessicus* (Kaup, 1832) or that of the same elements in late Miocene felids such as *Paramachairodus orientalis*, *Promeganteron oggygia*, *Metailurus parvulus* and *Felis panmirii* Özansoy, 1965. In contrast, the size of the phalanx figured by Malik & Nafiz (1933) is taller relative to its length. The phalanx is not diagnostic at the genus level.
Considering the limited material available to me, the fauna from Küçükçekmece is relatively rich. Taxa are not equally documented though. Five species are known from a single specimen: Indarctos arctoides, Sivaoxyx bessicus, cf. Thalassictis sp., Pristifelis sp. cf. P. attica and Felidae gen. et sp. indet. medium size. In contrast, the majority of the fossils (18 of the 34 specimens) belong to the family Phocidae. The sample from Küçükçekmece in fact represents the only published description of this family in the Neogene of Turkey. Isolated finds are mentioned by Koretsky & Rahmat (2013: 328) without precision and by Ozansoy (1957) from the sites of Ramiz and Osmanly; Phoca pontica is mentioned but not described from Çanakkale (= Erenköy; Ozansoy 1957).

Overall, the carnivoran fauna from Küçükçekmece indicates a late Miocene age for the locality. Many of the taxa have a range extending over several MN-zones. Thus, Indarctos arctoides, Di-nocrocus senyurekii and Machairodus aphanistus are known from MN9 to MN11. One species, Sivaoxyx bessicus, was previously known only from early Vallesian strata (MN9). The indeterminate species cf. Thalassictis sp. and Pristifelis sp. cf. P. attica show derived features that are more consistent with a late Vallesian or Turolian age (MN10-MN12). The phocid Cryptophoca sp. is related to a species that has a wide stratigraphic range (late Astaracian-early Turolian; Koretsky 2001: fig. 63).

The site Küçükçekmece has yielded a surprisingly rich fossil fauna of Carnivora. It is unusual in representing one of the rare fossil Miocene assemblages that include both marine and terrestrial taxa. Among the taxa identified, less than half can be assigned to species. The others are documented by too fragmentary remains. Unfortunately there is little chance to find more fossils at Küçükçekmece, which decades ago became a very dense urban area now part of the European part of Istanbul.

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