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Latest Miocene Myliobatids (Batoidei, Selachii) from the Alvalade Basin, Portugal

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Myliobatid teeth from the Esbarrondadoiro Formation (Alvalade Basin, Portugal) are described. These teeth have been attributed to the genera *Aetobatus* (represented by *A. cappettai* n. sp.), *Myliobatis* (*M.* cf. *aquila*) and *Pteromylaeus* (*P.* sp.). Other Myliobatid teeth are from an extinct genus whose taxonomic status remains unresolved.

São descritos dentes de Myliobatidae colhidos em depósitos da Formação de Esbarrondadoiro (Bacia de Alvalade), dos géneros *Aetobatus* (representado por *Aetobatus cappettai*, nov. sp.), *Myliobatis* (*M.* cf. *aquila*) e *Pteromylaeus* (*P.* sp.). Outros dentes, pertencentes a géneros extintos, são de posição taxonómica ainda não esclarecida..

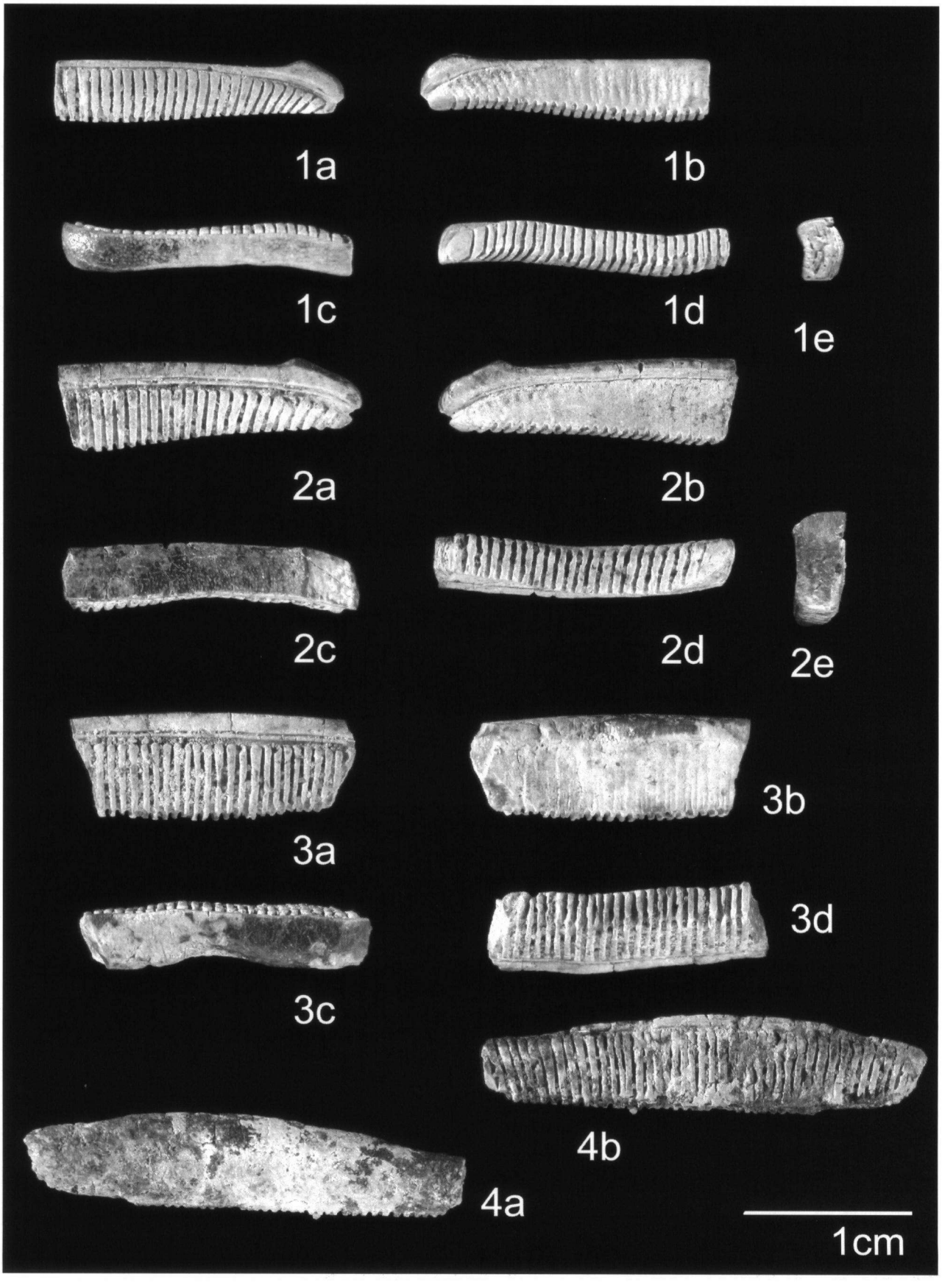
KEY WORDS: Myliobatidae, Alvalade Basin, Miocene, new species.

Introduction

The Alvalade basin (Portugal) began its differentiation in the lower Alentejo region in Late Miocene times. A horst composed of Paleozoic rocks (the Valverde horst) separated this depression from the much larger lower Tagus basin (Antunes, Mein & Pais, 1986). Subsidence allowed two successive marine transgression events. The older event is probably correlated to the lower part of the Cacela Formation in the Algarve, of Late Tortonian age, as suggested by the corresponding mollusc fauna. The second event is marked by the deposition of mostly sandy, microfossil-poor sediments (occassionally pelitic in some areas) of the Esbarrondadoiro Formation.The Esbarrondadoiro Formation yields molluscs, a rich marine fish fauna and rare freshwater fishes (Antunes *et al.*, 1995), chelonians (*Trionyx*), marine mammals and (in the same beds) a few land mammals: mastodont, *Hipparion* and remnants of other larger mammals, as well as lagomorphs, rodents and insectivores (Antunes, 1984; Antunes, Mein & Pais, 1986; Antunes & Mein, 1989, 1995). Small mammals are indicative of the MN13 zone (Late Turolian, ca 5-6 Ma). This age more or less corresponds to the Messinian (Latest Miocene). The marine fish fauna of the Esbarrondadoiro Formation clearly differs from fish faunas of Pliocene age from SE Spain (as one of us, M.T.A., could observe in material from the Elche area) and Belgium (Antunes, 1978; Cappetta, 1987). The most evident difference lies in the absence of the extant great white shark, *Carcharodon carcharias* Linné, 1758, that was more common in Pliocene than the at the time declining *Carcharocles megalodon* Agassiz, 1843. Teeth of *C. carcharias* are too large to pass unnoticed after washing and sieving of tons of sediments from the Esbarrondadoiro Formation. Thus, a somewhat older than Pliocene age is inferred for the Esbarrondadoiro fauna which is compatible with the mammal-based, Latest Miocene age indications. The selachian fauna is rich in taxa and in specimens. It is the most modern among Miocene faunas from Europe (Balbino, 1995; Antunes *et al.*, 1999; Balbino & Cappetta, 2000). This paper deals with one of the main batoid families from the Alvalade Basin, the Myliobatidae.

Material

All material is from three outcrops of the Esbarrondadoiro Formation in the Alvalade basin (Baixo Alentejo Province, Southern Portugal). These are: Santa Margarida, Esbarrondadoiro and Vale de Zebro (see Balbino & Cappetta, 2000 for further details). The Formation is of Late Miocene (Messinian) age and also assigned to the MN13 mammal–zone (Late Turolian). Based on magnetostratigraphy an age between 5.3 and 5.8 Ma has been inferred for these deposits.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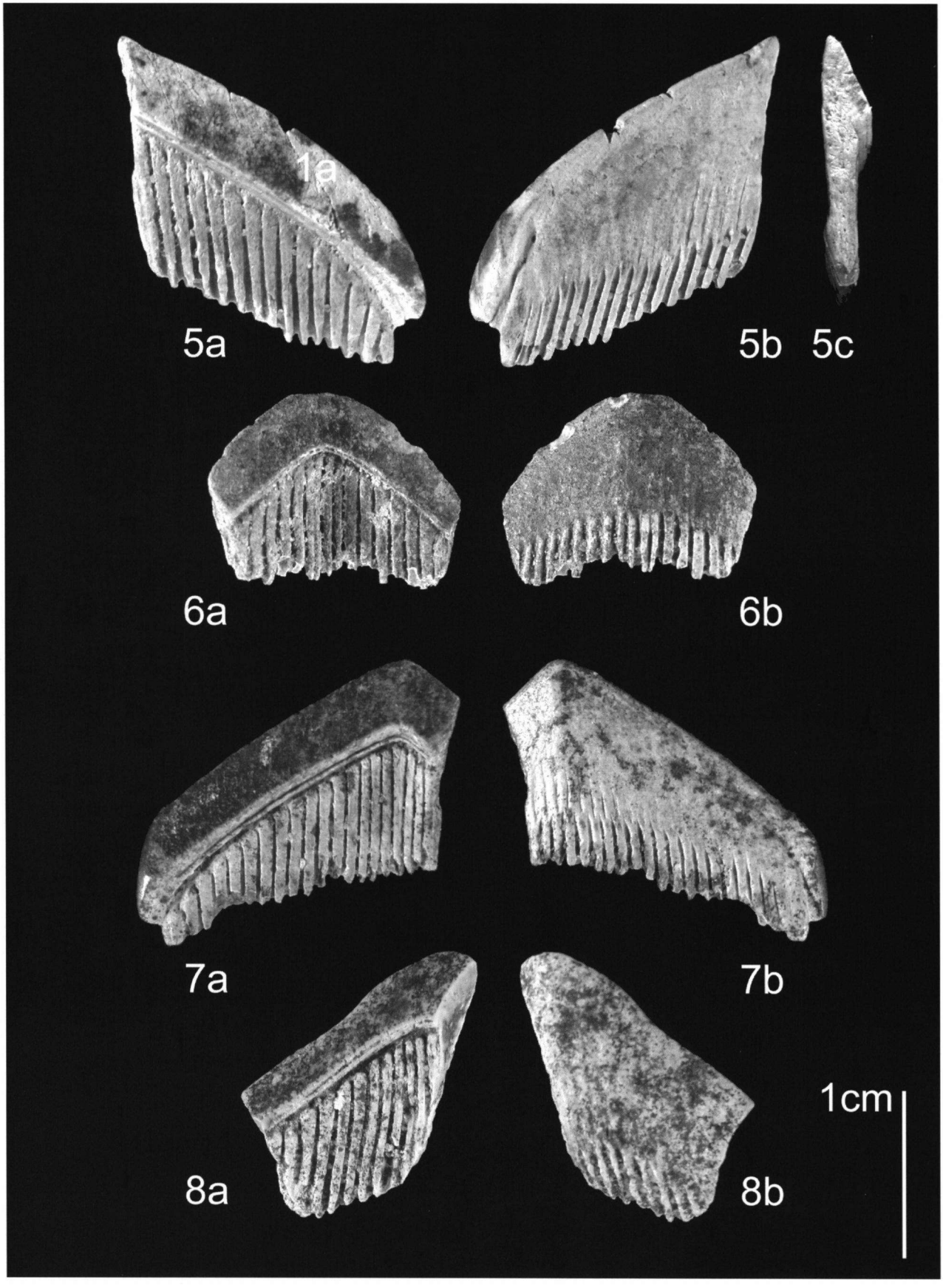


All specimens are from Esbarrondadoiro (Baixo Alentejo Province, Portugal), collected in the Late Miocene Esbarrondadoiro Formation by the authors.

Figures 1-8. *Aetobatus cappettai* Antunes & Balbino, nov. sp.: (1-4) upper dentition, (5-8) lower (mandibular) dentition. 1 – Incomplete tooth: a, labial view; b, lingual view; c, occlusal view; d, basal view; e, profile. 2 – holotype (SEV 20), incomplete tooth : a, labial view; b, lingual view; c, occlusal view; d, basal view; e, profile. 3 – Incomplete tooth: a, labial view; b, lingual view; c, occlusal view; d, basal view. 4 – Nearly complete tooth: a, occlusal view; b, basal view. 5 – Incomplete tooth: a, occlusal view; b, basal view; c, profile. 6 – Nearly complete tooth: a, occlusal view; b, basal view. 7 - Incomplete tooth: a, occlusal view; b, basal view. 8 – Incomplete tooth: a, occlusal view; b, basal view.

Institutional abbreviations –

MP Paleontology Laboratory, Université de Montpellier II, Montpellier, France;
SEV Palaeontological Collections, Évora University, Évora, Portugal.

Systematic palaeontology

Class Chondrichtyes Huxley, 1880
Subclass Elasmobranchii Bonaparte, 1838
Superorder Batomorphii Cappetta, 1980
Order Myliobatiformes Compagno, 1973
Superfamily Myliobatoidea Compagno, 1973
Family Myliobatidae Jordan, 1888

The family Myliobatidae comprises the following extant genera: *Aetobatus* Blainville, 1816, *Aetomylaeus* Garman, 1908, *Myliobatis* Cuvier, 1817 and *Pteromylaeus* Garman, 1913 (see Bigelow & Schroeder, 1953; Compagno, 1973). Nishida (1990) included in this family the genera *Rhinoptera* Cuvier, 1829, *Mobula* (Rafinesque, 1810) and *Manta* Bancroft, 1828, but excluded *Pteromylaeus*. Nelson (1994) subdivided the family Myliobatidae into the subfamilies Mobulinae (*Manta* and *Mobula*), Myliobatinae (*Aetobatus*, *Aetomylaeus*, *Myliobatis* and *Pteromylaeus*) and Rhinopterinae (*Rhinoptera*). Other myliobatid genera are only known from the fossil record: *Apocopodon* Cope, 1885, *Brachyrhizodus* Romer, 1942, *Garabatis* Cappetta, 1993, *Igdabatis* Cappetta, 1972, *Lophobatis* Cappetta, 1986, *Leidybatis* Cappetta, 1986 and *Pseudoaetobatus* Cappetta, 1986. The tooth morphology of all these genera is significantly different from that of other batoids. Its dentition is of the crushing type. The medial teeth are broad, juxtaposed into rows and forming (entirely or as the larger part) a dental plate. Medial teeth are flanked by (at most) 3 rows that become progressively smaller towards the commissure. In some Myliobatidae with a very specialized dentition, the lateral rows are much reduced or even lacking, whereas the medial row became progressively broader and may even constitute the whole dental plate (as in *Aetobatus*). The dental root is of the polyaulacorhize type, except in some genera where the very lateral rows of teeth have roots of the holaulacorhiza type. Myliobatids (also known as as angel-fishes) live in coastal, shallow, tropical to warm temperate waters.

Genus *Aetobatus* Blainville, 1816

Aetobatus cappettai n. sp.

Figures 1-8

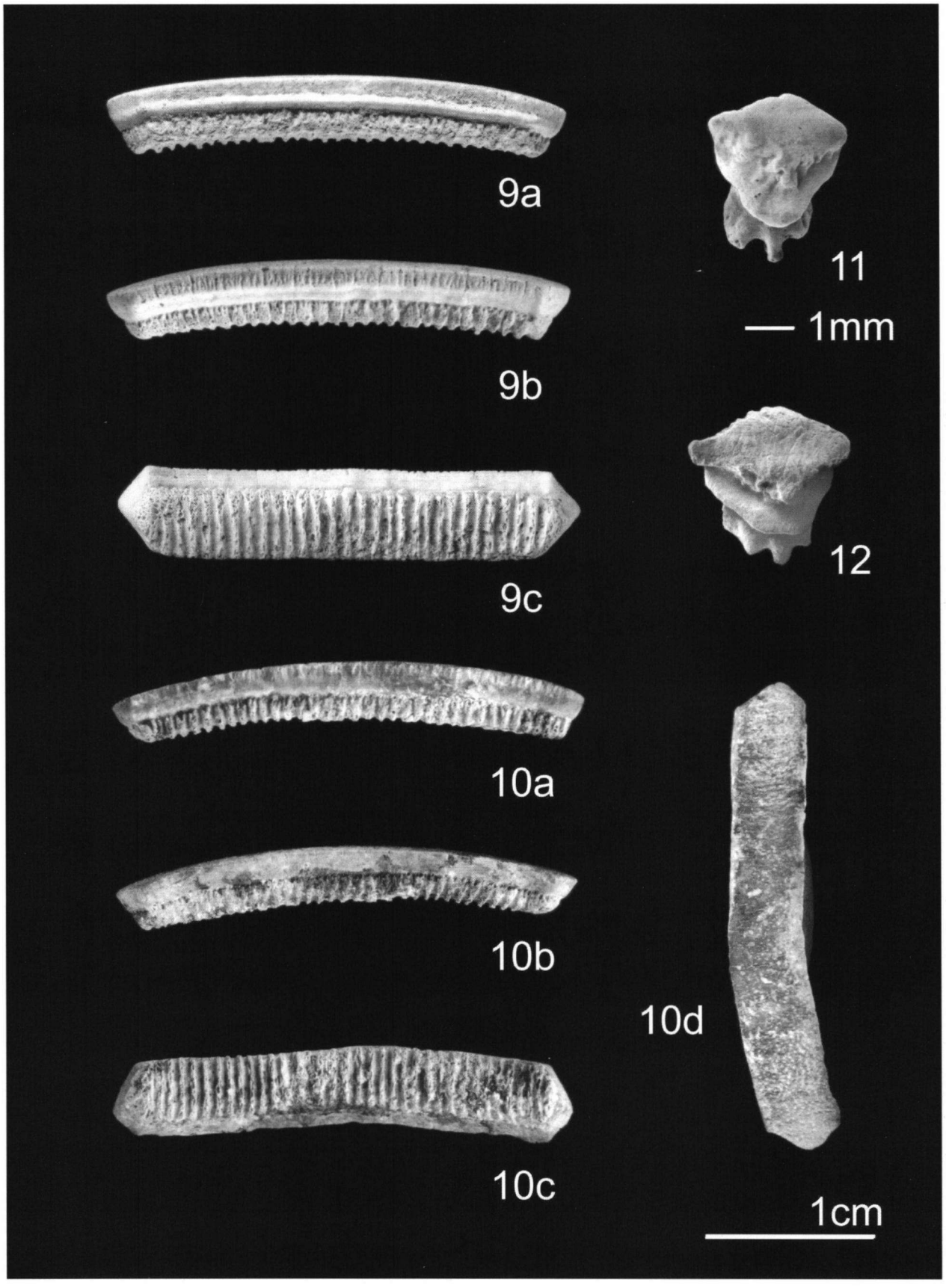
Holotype – SEV 20 Figures 2a-e. Type locality: Esbarrondadoiro in the Alvalade basin, Southern Portugal. Stratum typicum: Esbarrondadoiro Formation, Alvalade basin (Baixo Alentejo Province, Southern Portugal); Latest Miocene, late Messinian or MN13 mammal-zone on the basis of the small mammals from the same beds (corresponding to Late Turolian); magnetostratigraphic age, ca 5.3 to 5.8 Ma.

Other material studied – Santa Margarida (7 teeth), Esbarrondadoiro (258 teeth) and Vale de Zebro (51 teeth).

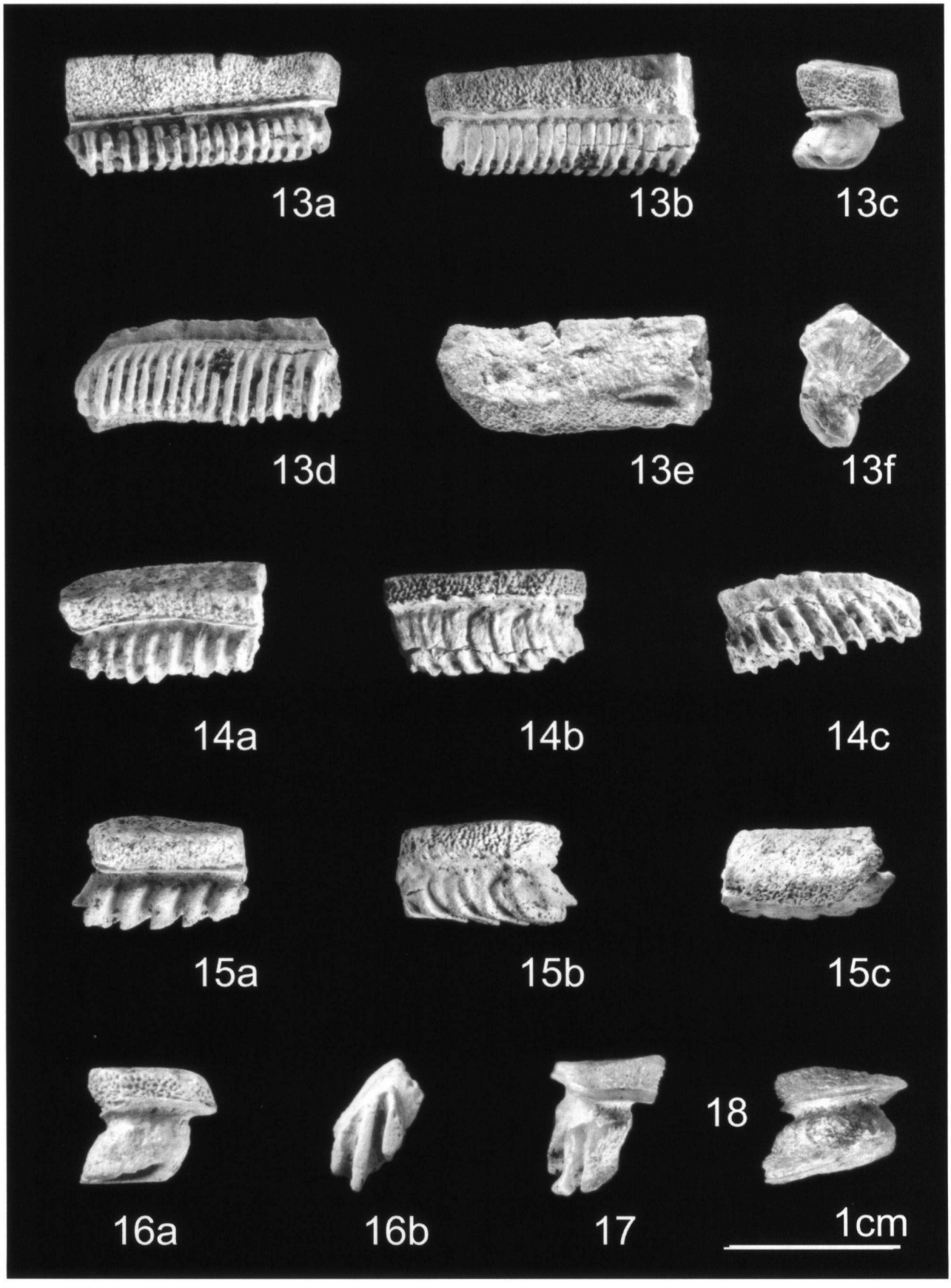
Derivatio nominis – The species name is dedicated to Dr. Henri-Charles Cappetta (Montpellier), a renowned paleoichthyologist whose collaboration we have greatly appreciated.

Diagnosis – Upper teeth narrow, long, slightly convex; crown low, thickened in the central part; lateral extremities prominent; root higher than crown, decreasing in height from the centre to the edges; blades on the labial face are almost smooth, lacking marked grooves; grooves on the lingual face very marked, they persist almost to the crown; basal surface of the root with narrow, deep grooves as well as blades, all of the same width; lower teeth arched and labially convex, extremely flat; basal angle ca 30°, with very oblique basal face; root high, thinning from the central part to the lateral edges; blades wide and separated by deep, wide grooves.

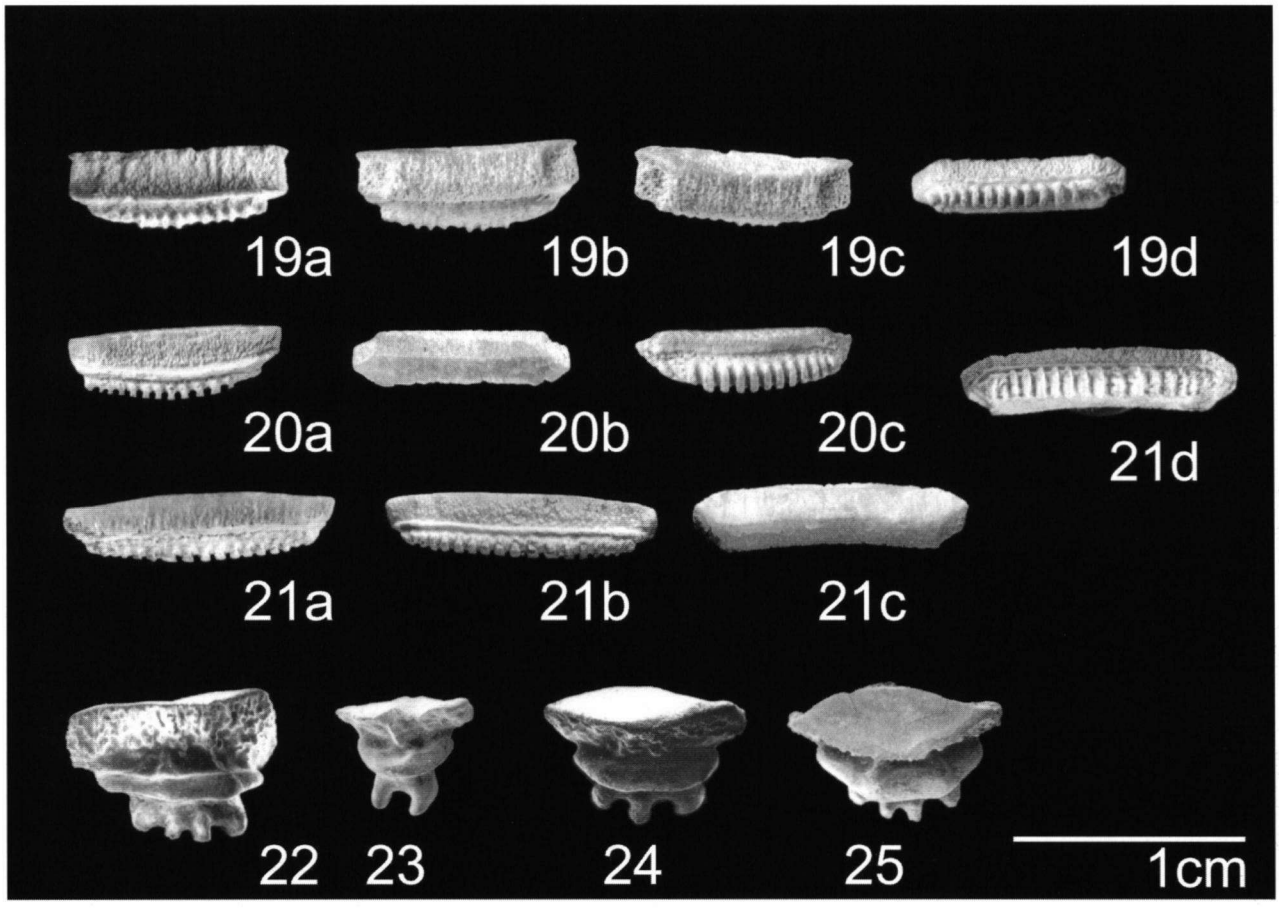
Description – The upper and lower teeth are notably different. The upper teeth are narrow, long and slightly convex. The crown is low and thicker in its central part. Lateral extremities are prominent; in occlusal view, the lateral extremities constitute a lateral border that is not affected by abrasion. The vertical, lingual face of the crown is separated from the root by a thin edge. The root is thicker than the crown; the thickness regularly decreases from the central part towards the borders (in lateral view). The basal surface presents alternating (narrow and shallow) grooves and blades. Width is the same in all blades, whose basal surface is flat. The tooth's labio-lingual section is nearly straight. The arched lower teeth are labially convex. The slightly oblique lingual and labial faces of the crown are parallel. The labial face of each tooth is superimposed on the root. It constitutes a prominent edge, under which the lingual border of the next tooth is located. This kind of teeth association results in a dental plate. The root is thick, but thickness diminishes towards the lateral borders. The blades are broader than those of the upper teeth roots. They are separated by broader and deeper grooves.



Figures 9-12. *Myliobatis* cf. *aquila* (Linné, 1758). 9 – Probably lower (mandibular) median tooth: a, labial view; b, lingual view; c, basal view. 10 – Upper median tooth: a, labial view; b, lingual view; c, basal view; d, occlusal view. 11 – Lateral tooth: occlusal view. 12 – Lateral tooth: occlusal view.



Figures 13-18. *Pteromylaeus* sp. 13 – Median tooth: a, labial view; b, lingual view; c and f, lateral views; d, basal view; e, occlusal view. 14 – Median tooth: a, labial view; b, lingual view; c, basal view. 15 – Median tooth: a, labial view; b, lingual view; c, occlusal view. 16 – Lateral tooth: a, lateral view; b, basal view. 17 – Lateral tooth: profile view. 18 – Lateral tooth: lateral view.



Figures 19-25. Myliobatidae indet. 19 – Median tooth: a, labial view; b, lingual view; c, occlusal view; basal view. 20 – Median tooth: a, labial view; b, occlusal view; c, basal view. 21 – Median tooth: a, labial view; b, lingual view; c, occlusal view; d, basal view. 22-25 – Lateral teeth: occlusal views.

Differentiation — Compared to *Aetobatus irregularis* Agassiz, 1843 (MP collection sample number RON 34, Late Eocene, Ronquerolles, Paris Basin, coll. MP; (Cappetta, 1986) the teeth of the new species are more arched and the width of the crown is not constant. In *A. irregularis*, the lower teeth are only slightly arched and their width is constant, the root being only slightly bent lingually. The new species has less arched lower teeth then *A. arcuatus* Agassiz, 1843 (Langhian, Loupian, Southern France, coll. MP). The labial and lingual faces of the root are oblique and prominently developed, the basal angle is ca 40°. The oblique root of the upper teeth of *A. arcuatus* is less lingually elongated. *Aetobatus cappettai* nov. sp. is similar to *A. narinari* Euphrasen, 1790 (Red Sea, MP REC 42), but differs from it by the inclination of the labial and lingual faces of the crown, the thickness of the lingual edge, the inclination of the root, the shape of the blades and of the grooves, as well as the basal angle.

Genus *Myliobatis* Cuvier, 1817

Myliobatis* cf. *aquila (Linné, 1758)
Figures 9-12

Material studied – Santa Margarida (47 teeth), Esbarradoiro (875 teeth) and Vale de Zebro (54 teeth).

Description – The median teeth are elongate, attaining 30 mm in length. Lateral teeth are much smaller. In occlusal view, the crown is more laterally developed than labiolingually. The nearly rhombic outline in occlusal view is bounded by concave latero-anterior borders. The very prominent lingual edge clearly superposes the trilobate root. Labial face is high, the lingual face is very short.

Discussion – Leriche (1910: 252) described in detail one form that he attributed to the extant species *Myliobatis aquila*. Cappetta & Nolf (1991: 62) attributed a single lateral tooth to *M. aquila*. The studied teeth, and especially the lateral teeth are very similar to those of *M. aquila*. However, the range of morphological variation within the teeth of Myliobatidae makes a certain identification impossible.

Genus *Pteromylaeus* Garman, 1913

***Pteromylaeus* sp.**
Figures 13-18

Material studied – Santa Margarida (15 teeth), Esbarrondadoiro (179 teeth) and Vale de Zebro (77 teeth).

Description – The genus *Pteromylaeus* is represented by very thick teeth fragments. The crown is thick (the thickness diminishes laterally), with a plate, but with irregular occlusal surface. The vertical lingual face presents a distinct ornamentation, and an edge that is separated from the crown by a well-marked furrow. The labial surface, also vertical, is ornamented. The root is lingually inclined. Blades and grooves are well marked, almost until the anterior end (close to the edge). The posterior extremities are free, so the posterior border is irregular. The lateral teeth are much smaller. Their outline is polygonal (4 or 6 sides) in occlusal view. The crown (although affected by abrasion) is shorter than the root, which is mesio-distally lengthened; it has 2 to 4 blades. Grooves are deep but do not attain the lingual edge.

Discussion – The teeth described may be assigned to *Pteromylaeus* by their morphologic characters. However, their incomplete nature as well as the lack of teeth in association prevents us to reach their determination at the species' level.

Myliobatidae indet.
Figures 19-25

Material studied – Esbarrondadoiro (63 teeth).

Description – The small median teeth are hexagonal in outline. The enameled occlusal surface presents a middle cutting edge. The high lingual face has a granular ornamentation and a cutting, prominent lingual ridge. The labial and lingual borders are near parallel. The crown is larger close to the marginal angles than at its base. The separation between the crown and the root in the lingual face is made by a prominent, rounded border. The root is lower than the crown and presents about 12 blades that are separated by deep grooves. The root's thickness diminishes from the central part towards the lateral borders. The lateral teeth are smaller than the median ones. The crown is high; abrasion results in a plate, grossly lozengic, mesio-distally lengthened area. The labial ridge shows a prominent median angle that corresponds to a vertical edge in the lingual face. The broad, lower border of the labial ridge is slightly concave close by the marginal angles. The root comprises 3 blades separated by 2 deep grooves.

Discussion – As far as we can judge, the studied myliobatid teeth are quite different from those of the genera with extant representatives. A more accurate identification does not seem possible.

Discussion and conclusions

One species of *Aetobatus*, *Myliobatis* and *Pteromylaeus* together with a fourth unidentified myliobatid make up the myliobatidae fauna of the Late Miocene Esbarrondadoiro Formation in Alvalade basin (Portugal). *Aetobatus cappettai* n. sp. is introduced for the *Aetobatus* material. The very broad dental variation in *Myliobatis* and *Pteromylaeus* does not allow identification of isolated, often damaged teeth at the species level.

	Santa Margarida	Esbarron-dadoiro	Vale de Zebro	Total
Aetobatus cappettai n. sp.	7	258	51	316
Myliobatis cf. *aquila*	47	875	54	976
Pteromylaeus sp.	15	179	77	271
Myliobatidae indet.	-	63	-	63
Total	69	1375	182	1626

Table 1. Studied material

Myliobatis cf. *aquila* (Linné, 1758) is the most common myliobatid species in the studied material, making up ca 60% of the specimens. *Aetobatus cappettai* n. sp. (19%) and *Pteromylaeus* sp. (17%) are also common species. Myliobatidae indet. (4%) are rare, and restricted to the locality of Esbarrondadoiro. The relative abundances of the three identified Myliobatid species among the three localities are broadly similar, with the exception of *Myliobatis* cf. *aquila* that is underrepresented in the locality of Vale de Zebro. Densities of Myliobatid teeth are especially low in the Santa Margarida outcrop. The sedimentology indicates that Esbarrondadoiro sediments were deposited in deeper waters than the Santa Margarida more littoral, higher-energy ones where molluscs would be less common, possibly explaining the lower abundance of molluscivorous Myliobatids in the last locality.

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