

Discovery of the Genus *Gymnura* (Batomorphii, Myliobatiformes) in the Thanetian of the Ouled Abdoun, Morocco. Observations on the Dentition of some Modern Species.*

Original French text by **Henri Cappetta**

[An English translation of the abstract is provided in the original article]

Introduction

The remains of batoids are abundant in the phosphatic formations of Morocco – as much in the Cretaceous as in the Paleogene with numerous species described by Arambourg (1952). It is necessary, however, to point out that compared to the Myliobatidae, the teeth of which are generally large, little about the smaller forms has been documented outside of some dasyatid species.

Sieving with fine mesh screens has allowed the collection of a micro-ichthyofauna including numerous new batoids of which the teeth are generally less than two millimeters. In this material teeth of the genus *Gymnura* have been recognized and they are the subject of this study.

The fossils come from the Thanetian of the test trench at “Recette 4” near the former phosphate-processing center Andre Delpit (see Cappetta, 1981).

At this site the Thanetian is represented by two poorly-indurated phosphatic layers: a lower one around one meter thick, poorly fossiliferous and beginning to draw even with the floor of the trench; an upper one from 40 to 50 centimeters thick and very rich in selachian teeth (DTH deposit). A phosphatic limestone of about 30 centimeters in thickness separates these two beds. The upper layer consists of a rather clayey phosphate, gray in color with a lot of reddish staining, which is easy to dry-screen. Above it lies more than two meters of limestone with two phosphatic intercalations about 20 centimeters thick overlain by about two meters of poorly-fossiliferous Ypresian phosphates with scattered flint beds.

The stratigraphy of the phosphate layers is well-established since the work of Arambourg (1952), who was able to report within each stage, a characteristic association of selachian species. Even if thorough, some corrections and additional details were necessary (Cappetta, 1981). The stratigraphy, as established by Arambourg, remains quite relevant in broad terms. The Recette 4 level, which yielded teeth of *Gymnura*, contains a characteristic association of the Thanetian (*Ginglymostoma africanum* Leriche., *Scyliorhinus africanus* Aramb., *Galeorhinus gomphorhiza* Aramb., *Squalus crenatidens* Aramb., and a number of new undescribed forms which have not been found in other beds within the phosphatic series).

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Systematics

Superorder Batomorphii
Order Myliobatiformes
Superfamily Dasyatoidea
Family Gymnuridae Fowler 1934
Gymnura delpiti nov. sp.
(pl. 1, fig. 1-7)

Material: about 100 teeth from the Thanetian at "Recette 4"
Type Locality: test trench at "Recette 4," about 2.5km to the SSE of the former phosphate-processing center Andre Delpit (DTH deposit).
Dimensions of the teeth figured (length x width of the crown in labial view in millimeters):
DTH 4: 1.59 x 1.37; DTH 5: 1.02 x 0.94; DTH 6: 1.26 x 1.42; DTH 7: 1.19 x 1.02; DTH 8: 1.27 x 1.21; DTH 9: 0.99 x 0.91; DTH10: 1.16 x 1.24.

Name derivation: from the name of the phosphate-processing center, Andre Delpit, now abandoned.

Age: Thanetian

Holotype: pl. 1, fig. 4a-c

Diagnosis: a species with symmetrical, strongly cuspidate anterior teeth and a low root with a reduced convex basal face; a well-marked anterior notch (= sinus) and prominent, wide, and rounded lateral angles in lateral and labial view. Asymmetrical lateral teeth with a flat, developed labial face and a deep anterior notch that becomes more shallow in the lateralmost files; sharp non-serrated transverse crest. Root is high, massive, bilobate and nearly as wide as the crown; lobes triangular in contour, separated by a deep groove clearly wider in its anterior region with a primary foramen in a central anterior position; small foramina are often present on the labial face of the root.

Description: The anterior teeth (pl. 1, fig. 1-2) are symmetrical with a long, upright, and narrow cusp - quite straightened in lateral view. In profile the lateral angles are well-developed and rounded; the labial face of the cusp is flat but quite depressed between the lateral angles. In lingual view the cuspidate part of the crown is laterally compressed, the lateroposterior faces are well-developed and the crown is narrower at its base than at the lateral angles. The root is low and bilobate with a well-developed, oblique, anterior face featuring foramina joining imperceptibly with the reduced and convex basal face of the lobes.

In the lateral files (pl. 1, fig. 3-6) the cusp is not as long, curving distally, and the teeth become asymmetrical. The mesial part of the crest is long and virtually rectilinear, while the distal part is shorter and concave. The labial face becomes more prominent due to the widening of the cuspidate part of the crown. The root is high, massive, and laterally-extended, virtually as wide as the crown in lingual view. The basal face of the lobes flattens with the contour becoming triangular. The anterior face always bears foramina.

The groove is deep and clearly wider in the anterior region. The root is always clearly separated from the crown all along its perimeter by a narrow depressed zone, analogous to the neck. The primary foramen is in a central anterior position. In the more lateral files (pl. 1, fig. 7), due to the transverse expansion of the teeth, the anterior notch tends to become more shallow and the labial face of the crown becomes very flat.

Distribution

This species has been collected in all of the Thanetian deposits sampled in the Ouled Abdoun. It has never been encountered outside of the Thanetian.

Observations on the dentition of modern gymnurids

Because of their minute size (for example, teeth 1mm in total width for a fish 1.9m in wingspan!), teeth of modern gymnurids have been figured in a most imperfect manner by zoologists. Only Bigelow and Schoeder (1953) and Lozano and Rey (1928) have published dentitions or details of a dentition of *G. altavela*, which although clearly insufficient, provide nonetheless an idea of the dental morphology of this family, at least with regard to the crown.

Today, the family Gymnuridae contains two genera: *Gymnura* Van Hasselt 1823 (= *Pteroplatea* Muller and Henle 1837), which lacks a dorsal fin, and *Aetoplatea* Muller and Henle 1841, possessing a small but distinct fin towards the tail area. However, the validity of the latter is in doubt (Compagno, 1973). Teeth of the type-species of *Aetoplatea* (*A. tentaculata* Muller and Henle 1841) do not exhibit marked differences from the teeth of most species within the genus *Gymnura*.

The genus *Gymnura* includes about ten modern species distributed in coastal and estuarine areas in tropical and warm-temperate regions. A detailed examination of the teeth of these modern forms would exceed the scope of this study but it would seem of interest, however, to figure and succinctly describe specimens to draw a comparison between *G. delpiti* nov. sp. and the teeth of three modern species, each representing a quite distinct morphological type.

In *Gymnura altavela* L., 1758 (pl. 1, fig. 8) the cusp is generally slender, fine-tipped (sometimes split-tipped as shown by Bigelow and Schroeder, 1953), the lateral angles are acute in oral view, widely-spaced and dip slightly towards the base. The labial sinus is wide and deep; the crown is labiolingually compressed. The root features a broad groove of generally consistent width (widening sometimes in its central region). The lobes of the lateral teeth are well-extended transversely. This pattern is found in most species with naturally some variation however: the cusp, more or less fine-tipped and erect; the sinus, more or less widened and deep; the lateral angles, more or less prominent and divergent; and the labiolingual compression of the crown, more or less accentuated.

In *G. micrura* (Schneider, 1801), the type species of the genus (pl. 1, fig. 9), the dental morphology is noticeably different. In oral view the crown is T-shaped. The oral face

consists merely of sharp cutting edges: one, transverse and in labial position joining the lateral angles, is virtually rectilinear; the other, perpendicular to the first one, emphasizes the upper part of the posterior cusp and unites with the median part at the anterior cutting edge. The point of convergence is marked by a weak protuberance. The anterior cutting edge can become jagged in its median region due to a labial modification of the lateral angles. The cusp is high, long, laterally-compressed and in profile clearly triangular. The root lobes are narrow and divergent, separated by a wide, deep groove with a very large foramen opening labially

In *G. marmorata* (Cooper, 1863) (pl.1, fig. 10) the labial sinus is very wide and open, the lateral angles being very widely-spaced. This species is characterized above all by the presence of a short but quite distinct accessory cusp on either side of the posterior cusp. In large adults the dental morphology changes noticeably: the teeth become higher, more massive; the main cusp tends to fork; the cusps become relatively more prominent, and the lateral angles are less finely-sharpened. The dentition as a whole becomes very irregular and heterogeneous with differentiation from teeth reduced to a simple cap to those with posterior cusps varying in number from one to four.

As a brief overview of the dentition of modern species, three quite distinct tooth types, also clearly different from each other, coexist within the genus *Gymnura*. One is also entitled to wonder if this genus is completely homogeneous or undoubtedly polyphyletic. The question is put to zoologists and anatomists.

Among modern species the teeth of one jaw are virtually all symmetrical except for two or three of the lateralmost files among which the cusp is more or less lingually-inclined with reduction or even disappearance of the distal lateral angle. The most transversely expanded teeth are positioned in the symphyseal region.

Discussion

Based on their morphology, the teeth of the Thanetian at Recette 4 belong unquestionably to the family Gymnuridae and to the genus *Gymnura*, which was until now poorly documented in the fossil record. It is well-represented in the Neogene of southern France, where it is encountered from the Aquitanian to the Middle Pliocene (Cappetta, Granier, and Ledoux, 1967; Cappetta, 1970 and pers. obs.). It was recently reported in the Early Eocene of England (Ward, 1983) without being figured, however. For the moment it is therefore difficult to establish direct comparisons between the new species from Morocco and the indeterminate one from England. *G. delpiti* nov. sp. is easily separable from modern species by its very wide, rounded, weakly divergent lateral angles in oral view, by its often lingually-distorted posterior cusp with a wide, flat upper face, by its slightly labiolingually compressed crown, and by its root with an irregularly wide groove – wider in its anterior part.

The teeth collected in the Neogene of southern France are morphologically very close to those of modern species. It is impossible, however, to specifically determine these relationships without a detailed study of modern species. The differences noted above,

greater between *G. delpiti* and modern species, are therefore also relevant to the teeth of the Neogene.

The family Gymnuridae includes a fossil genus known only from the Middle Eocene of Belgium: *Jaquhermania duponti* (Winkler, 1874) (Cappetta, 1982). The teeth of this genus bear a laterally-compressed, bulky crown with a very upright cusp, close-set lateral angles, a shallow sinus, and a low lingually-inclined root – often wider than the crown. They are easily separable from those of *G. delpiti* even in the lateral files, where the just-listed characters are less accentuated.

The differences in the dentition are quite marked between *G. delpiti*, the teeth being asymmetrical starting from the anterolateral files, and Neogene-Recent species, of which only the lateralmost files exhibit a lingually-inclined cusp.

Conclusions

The discovery of *Gymnura* teeth in the Late Paleocene of Morocco extends the stratigraphic distribution of this genus, which was until now unknown before the Ypresian. This is the first time that the family Gymnuridae has been documented as a fossil from Africa as well.

Within the stratigraphic framework *Gymnura delpiti* appears to be a good index fossil within the extent of the basin from the standpoint that among the numerous conducted samplings, it has not been encountered outside the Thanetian.

Despite this ancient occurrence, this species, unfortunately, sheds little light on the origin of the family. Indeed, although distinguished by a number of characters from Recent species, the teeth of the fossil species already feature a morphology typical of *Gymnura*.

The study of the dentition of modern species allowed the demonstration of morphological differences, at times significant between species, and the recognition of three groups: one represented by *G. micrura*; another by *G. marmorata*, and a third grouping of other species, of which *G. altavela* is a good example. The noted differences within the framework of the dental morphology begs the question of the homogeneity of the genus *Gymnura*. By its dental morphology *G. delpiti* nov. sp. is unquestionably related to the *G. altavela* group.

From the standpoint of the evolution of the dentition, one notes an accentuation of the clutching-type, which manifests itself among modern species by a more finely-sharpened, longer, and more upright cusp than in the fossil species of the Paleocene.

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