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Fish otoliths from the Middle Eocene (Bartonian) of Yebra de Basa, province of Huesca, Spain

by Rostislav BRZOBOHATÝ & Dirk NOLF

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Abstract

Otoliths collected in the basal part of the Pamplona Marl at Yebra de Basa allow reconstituting a teleost fauna of 31 taxa, including 18 nominal species. The association is dominated by a single species, *Apogon dominans* n. sp. (92 % of all otoliths; more than 5 000 specimens in the collection). This assemblage reflects a very shallow neritic environment and shows a similarity with otolith assemblages of the European Middle and Upper Eocene. The Yebra de Basa otolith fauna completes our data on the Middle and Late Eocene ichthyofaunas of the Pyrenean realm by providing a neritic Bartonian fauna, including six new species: *Onuxodon yebraensis*, *Apogon dominans*, "genus aff. *Apogon*" *viaboadai, Mene iberica, Chaetodipterus steurbauti* and *Pardachirus izarrae*.

Keywords: Teleosts, otoliths, Eocene, Bartonian, Spain.

Résumé

Les otolithes récoltées à la base des Marnes de Pamplona à Yebra de Basa permettent la reconstitution d'une faune de 31 taxa dont 18 ont pu être identifiés au niveau de l'espèce. L'association est dominée par une seule espèce, *Apogon dominans* n. sp. (92 % de toutes les otolithes récoltées, plus de 5 000 spécimens dans la collection). Cet assemblage indique un environnement côtier très peu profond et ressemble beaucoup à celles de l'Eocène moyen et supérieur d'Europe. Les otolithes de Yebra de Basa complètent nos données sur les ichthyofaunes d'âge Eocène moyen et supérieur du domaine pyrénéen en fournissant une faune néritique d'âge Bartonien qui inclut six espèces nouvelles: *Onuxodon yebraensis*, *Apogon dominans*, "genus aff. *Apogon*" *viaboadai, Mene iberica, Chaetodipterus steurbauti* et *Pardachirus izarrae.*

Mots-clefs: Téléostéens, otolithes, Eocène, Bartonien, Espagne.

Introduction

About 1990, the presence of an otolith-bearing layer at Yebra de Basa, east of Huesca in the Southern Spanish Pyrenees, was mentioned to us by the late Luis Via Boada, Director of the Geological Museum in the Seminar of Barcelona. D. Nolf visited the site with J. Samso, geologist at the Catalan geological mapping survey in 1991. After this first prospecting, the site was extensively sampled (about 500 kg of sediments were washed) and provided a rich otolith association. The concerned bed is a *Turritella*-rich layer at the base of the Pamplona Marl, just above the Sabiñánigo Sandstone. Both are well exposed near to a small chapel west of Yebra de Basa (Cartografía Militar de España, sheet 210, Yebra de Basa, x = 723.400, y = 4707.100).

Geological and stratigraphical context

The molassic sedimentation in the Jaca Basin was described and mapped in detail by PUIGDEFABRIGAS (1975). The Middle Eocene Pamplona Marl forms part of the sedimentary infill of the Jaca Basin (West-Central Pyrenees), one of the sub-basins of the South Pyrenean Foreland Basin. The Jaca Basin evolved as a piggyback structure during the Pyrenean orogeny (Fig. 1). More to the east the Jaca Basin is partly separated from the Ainsa sub-basin by the Boltaña Anticline. To the west it opens towards the Pamplona Basin. Fold and thrust belts of the Internal Sierras (Sierra de Barraquas and Sierra de Galardón) and External Sierras (Sierra de Loarre and Sierra de Belarre) delimit the Jaca Basin respectively in the north and in the south. The infill of the basin is most complete in its northern part, where the Lower and Middle Eocene marine strata were

deposited. In the southern part of the basin, continental and younger sediments prevail.

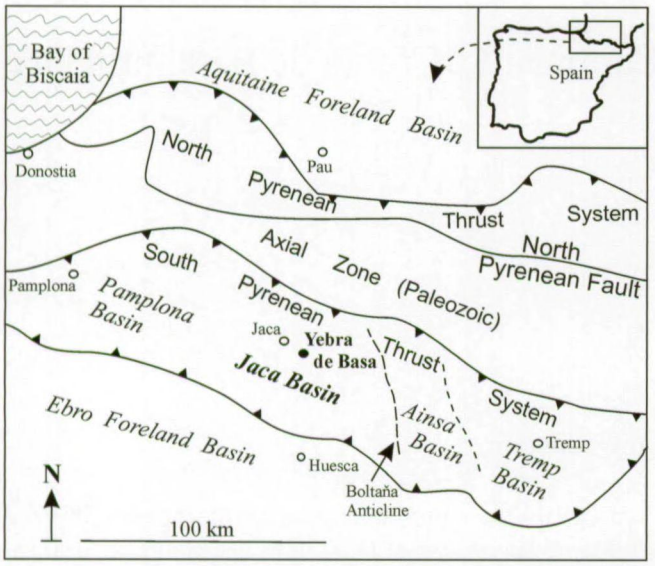

Fig. 1 – Geographical and geological position of the Yebra de Basa locality (after SCHELLART, 2002 and BAUER 2008; modified).

The Middle Eocene in the northern part is represented by deep-sea turbidites of the Hecho-Group overlain by the Larrés Marl, Sabiñánigo Sandstone and Pamplona Marl (Fig. 2). The Larrés Marl represents a transition from deep marine to shallower marine deposition. The last two members crop out near Yebra de Basa. The Sabiñánigo Sandstone is interpreted as a deltaic deposit with structures indicating tidal and wave action. The so-called Biarritz transgression in the early Bartonian was connected by a deepening of the Jaca Basin and the deposition of the Pamplona Marl, of deeper marine origin. The whole Jaca Basin section ends with the Upper Eocene Balsúe Atarés Formation, characterized by the restoration of shallow marine conditions (BARNOLAS & GIL-PEÑA, 2001; BAUER 2008).

Stratigraphically, the upper part of the Larrés Marl, the Sabiñánigo Sandstone and the lower part of the Pamplona Marl correspond to the *Truncorotaloides rohri* Biozone, which is of Bartonian age. The upper part of the Pamplona Marl belongs to the *Globigerinatheka semiinvoluta* Biozone and could represent the early Priabonian (CANDO & MOLINA, 1988). According to BARNOLAS & GIL-PEÑA (2001), however, the upper part of the Pamplona Marl is still Upper Bartonian. Based on large Foraminifera, the Larrés Marl, the Sabiñánigo Sandstone and the Pamplona Marl belong to the Shallow Benthic Zones 17 and 18 of SERRA-KIEL *et al.* (1998). On the magnetostratigraphic scale, the deposition of the three named units falls into Chron C18 and the boundary of the Sabiñánigo Sandstone/ Pamplona Marl is near to the Chron C18r/Chron C18n boundary (Early Bartonian, OMS *et al.*, 2003).

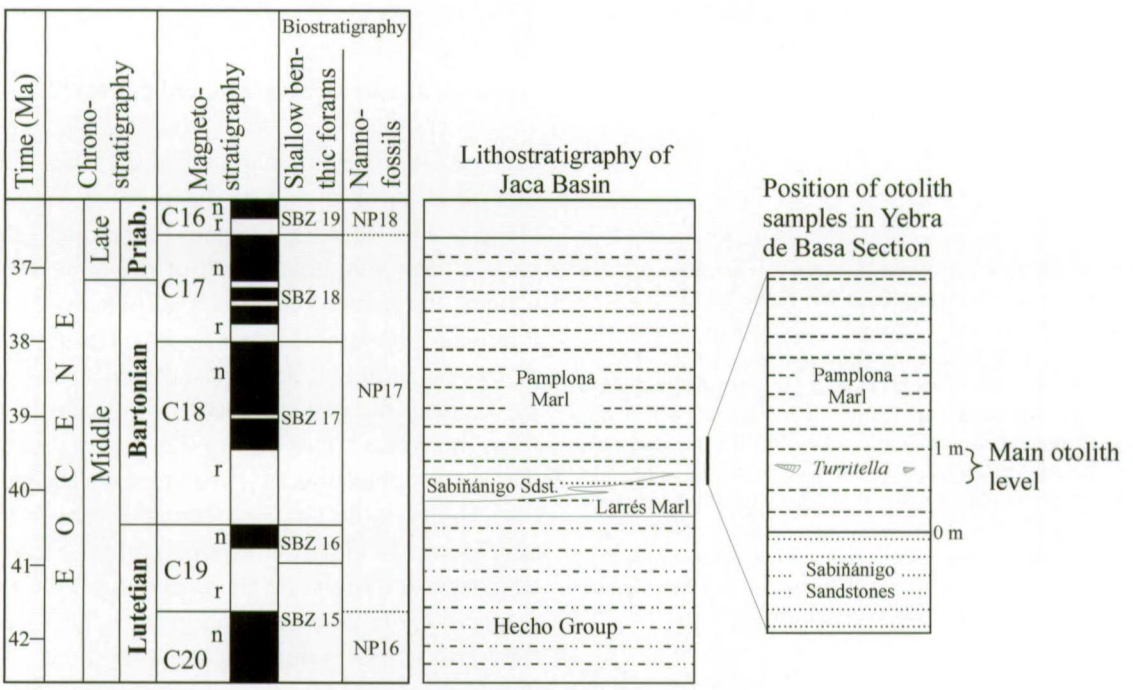

Fig. 2 – Stratigraphic position of the Yebra de Basa otolith level.

Systematic paleontology

Remarks on taxa requiring comments

Albula sp. (Pl. 1, Fig. 1)

A single non-diagnostic juvenile otolith. This specimen differs from known Eocene *Albula* species in having a shorter and only very slightly ventrally inflated caudal end.

"genus Nettastomatidarum" sp. (Pl. 1, Fig. 2)

Otoliths of nettastomatids are very rare in Cenozoic strata. Only two species, *Hoplunis ariejansseni* NOLF, 1988 from the Gan Clay (Ypresian) in Aquitaine, SW France and "genus Nettastomatidarum" *phaseoloides* (GAEMERS & HINSBERGH, 1978) from the Brinkheurne Member (Rupelian) in the Netherlands are known in the European Paleogene. One juvenile and well-preserved otolith from the Pamplona Marl (Pl. 1, Fig. 2) differs markedly from both species and shows certain similarities with otoliths of the genus *Venefica* (see e.g. NOLF, 1985, fig. 36 I). This similarity is best shown by comparison to otoliths of the Recent species *V. procera* (GOODE & BEAN, 1883), see CAMPANA, 2004, p. 24. The insufficient fossil material does not allow a more precise systematic attribution.

Saurida sp. (Pl. 1, Fig. 10)

Three well preserved juvenile otoliths, of which one is figured (Pl. 1, Fig. 10). The markedly more elongated shape distinguishes them from those of the contemporaneous *S. recta* (FROST, 1933) from the Paris, London and Belgian basins (see NOLF & CAPPETTA, 1976, Pl. 1, Fig. 14; STINTON 1977, pl. 6, fig. 10). The juvenile specimen of *S.* sp. (NOLF, 1988, pl. 4, fig. 14) from the Gan Clay (Eocene, Aquitaine) differs from Spanish otoliths by a much more convex dorsal rim. The Spanish otoliths are also different from three nominal Eocene species belonging to the "*Saurida*" group by their elongated elliptic shape and the dorsal rim without marked tips – see "genus aff. *S.*" *intermedius* (NOLF & CAPPETTA, 1976, pl. 1, figs 18-19), "genus aff. *S.*" *producta* (STINTON, 1980, pl. 14, fig. 29), and "genus aff. *S.*" *boulangeri* (NOLF, 1988, pl. 4, figs 15-16). The same could be stated for a comparison with "genus aff. *S.*" *indansi* (SCHWARZHANS, 1977, pl. 34, figs 3-4) from the German Lower Oligocene.

Surprisingly, similar regularly elongated otoliths without an excisura and antirostrum are found in the Middle Miocene: *S. germanica* WEILER, 1942 (see WEILER's pl. 4, figs 20, 21, 38). Despite the subtle differences, the Spanish otoliths seem to be relatively longer (index L:H = 2.8 vs. 2.5-2.6 at 2.9 mm length – see SCHWARZHANS, 2010, p. 50).

Glyptophidium polli (CASIER, 1946) (Pl. 1, Figs 11-13)

The stratigraphic range of this species is essentially Ypresian, where it can constitute over 90% of the associations in the Roubaix Clay and Mons-en Pévèle Sand of Belgium. It is also very common in the London Clay and the Gan Clay of Aquitaine. A few specimens are recorded in the Lutetian Brussel Sands, and NOLF (1988) mentions a single specimen from the Priabonian Brihande Marl in Aquitaine.

Antennariidae gen. et sp. indet. (Pl. 1, Fig. 14)

Five juvenile and eroded otoliths, of which one is figured (Pl. 1, Fig. 14). They differ from known otoliths of the Recent *Antennarius* species (e.g. *Antennarius hispidus* and *A. striatus* – SMALE *et al.*, 1995, pl. 35, figs A and B respectively; *A. pardalis* – NOLF, 1985, fig. 48 G; *A. tridens* – OHE, 1985, fig. 897), *Phrynelox zebrinus* – OHE, 1985, fig. 86; *Histrio histrio* – SMALE *et al.*, 1995, pl. 35, figs C1-2), but there are many Recent antenariid species whose otoliths are unknown. The mesial sulcus resembles that of the genera *Antennarius* or *Phrynelox.* However, because of the horizontal position of the sulcus, the fossils may be rather close to the genus *Histrio*.

A comparison with fossil species shows some similarity with otoliths of "genus Antennariidarum" *furcatus* FROST, 1933 from the Barton Clay of Southern England (Middle Eocene). But the morphology of the anterior rim of the Yebra de Basa specimens is more rounded and without a distinct tip. They also differ in their shape from *Antennarius euglyphus* STINTON, 1966 from the London Clay (Ypresian).

Holocentridae gen. et sp. indet. (Pl. 2, Figs 10-11)

Three eroded otoliths. The two figured specimens (Pl. 2, Figs 10-11) with a reasonably preserved sulcus show some similarity with otoliths of juvenile *Sargocentron* specimens, like *S. coruscum* (POEY, 1860) – see STEURBAUT, 1979, pl. 6, fig. 7 and *S. microstoma* (GÜNTHER, 1859) – see NOLF, 1985, fig. 13c. Otoliths of the Recent *S. inaequalis* RANDALL & HEEMSTRA, 1985 (see SMALE *et al.*, 1995, pl. 42, fig. E1) show a quite similar outline, but have a more ventrally directed caudal end than our specimens from the Pamplona Marl.

Lactarius amplus STINTON, 1978 (Pl. 2, Fig. 5)

Fishes of the genus *Lactarius* are only represented by one species, *L. lactarius* (BLOCH & SCHNEIDER, 1801), in the present day tropic Indo-West Pacific realm. However, the geological record shows much more diverse taxa, especially in the Eocene. The two otoliths from Yebra de Basa, one of which is perfectly preserved (Pl. 2, Fig. 5), correspond quite well to those of *L. amplus* from the Middle Eocene (Lutetian, Selsey Formation) of Southern England.

Sphyraena cf. *fluctuosa* (NOLF, 1973) (Pl. 4, Fig. 3)

Two otoliths from Yebra de Basa belong to juvenile fishes. One is perfectly preserved and is figured in Pl. 4, Fig. 3. It may be conspecific with *S. fluctuosa* occurring in the Eocene Lede Sand of Belgian and the Bracklesham Beds of Southern England (NOLF 1973, p. 98, pl. 1, fig. 8), but this cannot be confirmed just on the basis of such young specimens only.

Description of new species

Onuxodon yebraensis n. sp.

Pl. 2, Figs 1-4

Derivatio nominis

Latin adjective: *yebraensis,* from Yebra de Basa, the type locality of this new species.

Type material

Holotype: a left otolith (Pl. 2, Fig. 1) (IRSNB P 8842) and five paratypes of which three are figured (Pl. 2, Figs 2-4) (IRSNB P 8843 – P 8845).

Dimensions of the holotype

Length = 1. 9 mm, Height = 1. 4 mm, Thickness = 0.5 mm.

Stratum typicum

Basal Pamplona Marl at Yebra de Basa.

Diagnosis

This species is characterized by an approximately triangular outline, with a pronounced posterior tip and moderate and a considerable dorsal expansion. At the anterior margin a soft concavity, without a rostrum or an antirostrum, is visible. The outer face is convex in all directions. The inner face has a very smooth surface and is somewhat rounded at margins, but flat in the central part. The sulcus is not divided, and, in most specimens, narrows down towards the anterior part. The cristae are well developed. There is a flat depression in the dorsal area and the marked ventral furrow borders the entire ventral margin. Juvenile specimens are shorter with more pronounced dorsal expansion and narrower dorsal area.

Remarks

In the fossil record, *Onuxodon* otoliths are known, in the first place, from the Eocene and Lower Oligocene strata of Aquitaine. At a first glance, *O. kiriakoffi* NOLF, 1980 differs by markedly longer otoliths with an extended posterior end, whereas the holotype of *O. coheni* NOLF, 1980 is higher with the very short posterior end. The same could be said for *O.* aff. *coheni* from the Priabonian of Italy (GIRONE & NOLF, 2009, pl. 3, fig. G).

Five otoliths from the Bartonian of the London Basin are described as *Hymenocephalus fimbriatus* of which two eroded specimens are figured (STINTON, 1977, Pl. 7, figs 10-11). This species was rejected by NOLF (1985) because of the strongly eroded holotype. Recently SCHWARZHANS & BRATISHKO (2011, pl. 7, figs B-D) figured three reasonably well preserved *Onuxodon* otoliths from the Barton Formation under the name *Onuxodon fimbriatus* (STINTON, 1977), but these good specimens do not legitimate the use of a name based on extremely worn type material. These otoliths differ from *O. yebraensis* in the more pointed posterior end, higher dorsal expansion and a markedly oblique posterior part of the ventral margin. *Onuxodon* sp. from the Selandian of Ukraine (SCHWARZHANS & BRATISHKO l.c., p. 7, fig. A) is represented only by one specimen with an eroded inner face.

Fishes of the genus *Onuxodon* (three species only) are restricted to the Indo-Pacific area today (NELSON, 2006) and their otoliths, e.g. *O. margaritiferae* (RENDAHL, 1921), see NOLF (1980, pl. 1, fig. 14) explicitly differ from the new species.

Apogon dominans n. sp.

Pl. 3, Figs 1-8

Derivatio nominis

From *dominans* (latin) = dominant, alludes to the dominant quantity of otoliths of this species in the Yebra de Basa association.

Type material

Holotype: a left otolith (Pl. 3, Fig. 1) (IRSNB P 8859) and more than five thousand paratypes of which

seven are figured (Pl. 3, Figs 2-8) (IRSNB P 8860 – P 8866).

Dimension of the holotype
Length = 3.1 mm, Height = 2.1 mm, Thickness = 0.7 mm.

Stratum typicum
Basal Pamplona Marl at Yebra de Basa.

Description
This species is characterized by nearly ellipsoidal otoliths with a regularly rounded, semicircular ventral rim. The rostrum is moderately short, blunt and markedly longer than the antirostrum. The excisura, nearly rectangular, is always present. The dorsal rim has a conspicuous anterodorsal angle preceded by a short and very oblique anterodorsal portion. There is a well-marked posterodorsal angle at the junction of the dorsal and the posterior rim. This angle is accentuated by some hollowing of the posterior part of the dorsal rim. This posterodorsal angle is located higher than the rostrum. The rounded posterior rim joins smoothly the ventral rim. All rims are smooth, but in juvenile otoliths the ventral rim shows some crenulation. The inner face is clearly convex with a smooth ventral portion. The outer face is convex in all directions. The well-incised sulcus has a median position, opens anteriorly and is filled with well-separated collicula and bordered by distinct cristae. The ostial part of the crista superior is markedly convex. A deep elliptic dorsal depression occupies the middle part of the dorsal area. The ventral area of adult specimens is entirely smooth with a distinct and narrow ventral furrow, located very close and parallel to the ventral rim.

Comparison
Otoliths of *A. dominans* are close to the relatively frequent Lower Eocene species *A. glaber* STINTON, 1966 from the London and Aquitaine basins. They differ in features of the dorsal rim: its morphology is more conspicuous, the anterodorsal angle is often sharp and shifted more anteriorly, the central part of the dorsal rim is approximately straight, the posterior concavity of the dorsal rim is markedly deeper and with a strongly protruding posterodorsal angle. These features are also present in juvenile specimens (Pl. 3, Fig. 8).

As stated by NOLF (1985, p. 13, figs A-F) the otoliths of various Recent *Apogon* species can only be distinguished by minor differences in their outline. Therefore, the otoliths of fossil apogonid species can be evaluated only on the basis of well-preserved and abundant material. This condition is perfectly achieved here and fully allows the definition of a new species from the Middle Eocene of North Spain.

"genus aff. *Apogon*" *viaboadai* n.sp.
Pl. 3, Figs 9-13

Derivatio nominis
This species is named in honor of the late Luis Via Boada, Director of the Geological Museum in the Seminar of Barcelona, who brought this important otolith locality to our attention.

Type material
Holotype: a right otolith (Pl. 3, Fig. 9) (IRSNB P 8867) and two hundred and twenty eight paratypes of which four are figured (Pl. 3, Figs 10-13) (IRSNB P 8868 – P 8871).

Dimension of the holotype
Length = 3.8 mm, Height = 2.1 mm, Thickness = 0.6 mm.

Stratum typicum
Basal Pamplona Marl at Yebra de Basa.

Description
This species is characterized by relatively long and posteriorly narrowing otoliths. The posterior portion of the dorsal rim is straight and stretches obliquely towards the posterodorsal angle, making the posterior portion of the dorsal area much lower than the anterior one. The anterior part of the dorsal rim is slightly convex, which convexity is followed by a well-marked angulous portion. A very shallow concavity can be observed just before the posterodorsal angle. The ventral rim, regularly curved, is smooth in adult specimens and crenulated in juveniles (Pl. 3, Fig. 13). The rostrum is moderately salient with a rounded tip. The antirostrum and excisura are visible in adult specimens only. The inner face is regularly convex in all directions, the outer face flat or slightly concave in central and posterior parts. The well-incised sulcus is filled by thick and well-separated collicula and entirely bordered by marked cristae. The straight and high crista superior dorsally limits the funnel-shaped ostium. A well-marked dorsal depression occupies nearly the entire anterior part of the dorsal area. The ventral area, approximately similar in surface to the dorsal area, has a well-developed furrow located very close and parallel to the ventral rim.

Remarks

"g. aff. *A.*" *viaboadai* is easily recognized by the characteristic ostial form. In outline the otolith resembles *A. decoratus* STINTON (1980, pl. 14, fig. 20). However, the margins of adult specimens of the newly described species are rather smooth in comparison with the strongly crenulated margins of Stinton's species.

The straight ostial crista superior also occurs in otoliths of the genera *Cheilodipterus* and *Holapogon* – see *Ch. lineatus* LACEPEDE, 1801 (SMALE *et al.*, 1995, pl. 67, figs F1-2) and *H. maximus* (BOULANGER, 1887), see e.g. NOLF (1985, fig. 62H). The cauda of otoliths of both Recent taxa is markedly shorter than the ostium.

Mene iberica n. sp.
Pl. 2, Figs 12-16

Derivatio nominis

From *ibericus* (*-us, a, um*, Latin) = from the Iberic peninsula, refers to the type region.

Type material

Holotype: a right otolith (Pl. 2, Fig. 16) (IRSNB P 8853) and ten paratypes of which four are figured (Pl. 2, Figs 12-15) (IRSNB P 8854 – P 8857).

Dimension of the holotype

Length = 1.8 mm, Height = 1.5 mm, Thickness = 0.4 mm.

Stratum typicum

Basal Pamplona Marl at Yebra de Basa.

Description

This species is characterized by small, moderately thin, rather elongated and anteriorly narrowing otoliths reaching about 2 mm in length. The dorsal rim is smooth or undulated and ends with a smooth but well marked posterodorsal angle. The slightly undulated ventral rim is characterized by a salient, sharp and posteriorly located ventral angle. There is a short and usually notch-like concavity between the ventral and posteroventral angle (very well marked in the specimen figured on Pl. 2, Fig. 13). The anterior part of the ventral margin is long and rises obliquely, sometimes with a slight concavity, to the markedly protruding but bluntly rounded rostrum. The posterior rim is nearly vertical, sometimes very slightly convex. The excisura and antirostrum are almost obsolete.

The inner face is strongly convex, especially in the antero-posterior direction. The wide and deeply incised sulcus is clearly divided in a rather funnel-shaped ostium and a narrower, posteriorly widened cauda. The caudal colliculum forms a distinct lower collicular crest. The crista superior and inferior are well developed; the first one is strongly concave in the middle part and turned upward posteriorly. The second one is nearly straight and becomes obsolete at the caudal end. The cauda is not closed and is down swept at its posterior end. The dorsal area has a well-marked depression, the ventral area shows some hollowing just below the crista inferior. There is no clearly developed ventral furrow.

The outer face has a smooth surface and is entirely convex in the dorso-ventral direction, but concave in the antero-posterior direction. The strongest hollowing is located near to the rostral part. It makes a typical hook-like profile of the otoliths in ventral view (Pl. 2, Fig. 16). The juvenile specimen and an eroded specimen are figured in the Pl. 2, Figs 12 and 14 respectively.

Remarks

The entire otolith morphology of *M. iberica* is close to what is observed in the Recent species *M. maculata* (BLOCH, 1801) (see NOLF, 1985, fig. 64A) and the Eocene species *M. sekharani* NOLF & CAPPETTA, 1976. Compared to the Recent species, the studied otoliths are generally shorter with a not so clearly separated anterior portion. They differ from *M. sekharani* in the more compressed outline, the more anteriorly located ventral tip, the notch-like concavity behind it, the missing ventral furrow, and the nearly equal length of the both sulcus parts.

Other relatively rare fossil menids, different from the genus *Mene*, were evaluated by NOLF & BAJPAI (1992) and recently by NOLF, RANA & SINGH (2006): „g. Menidarum" *ornatissimus* (NOLF, 1988), „g. M." *occultus* NOLF & BAJPAI, 1992, and "g. M." *inflatus* NOLF, RANA & SINGH, 2006. They differ from *M. iberica* by their much shorter ostium.

Chaetodipterus steurbauti n. sp.
Pl. 4, Figs 7-8

Derivatio nominis

This species is dedicated to Etienne Steurbaut (IRSNB, Brussels) for his many contributions to the knowledge of fossil otoliths and Paleogene stratigraphy and geology, and in honor of all the careful work spent in editing the Institute's Bulletin.

Type material

Holotype: a left otolith (Pl. 4, Fig. 7) (IRSNB P 8883)

and one figured paratype (Pl. 4, Fig. 8) (IRSNB P 8884).

Dimension of the holotype
Length = 2.9 mm, Height = 2.9 mm, Thickness = 0.6 mm.

Stratum typicum: Basal Pamplona Marl at Yebra de Basa.

Description
Otoliths of this species are characterized by a diagonal elongation in the anteroventral-posterodorsal direction, with well-marked dorsal angles and a semicircular ventral rim. The central part of the dorsal rim between the two angles is straight. The anterior and posterior parts of the dorsal rim decline obliquely down. The ventral rim is slightly and irregularly undulated. The excisura is very marked. The strong and blunt rostrum is more pronounced than the sharper and shorter antirostrum. The posterior rim is generally convex and makes a distinct notch at the caudal level in the holotype, whereas there is only a slight concavity at the same place for the paratype. This difference is probably of an ontogenetic nature.

The inner face is convex in all directions with a deeply incised and clearly divided sulcus. The ostium is much deeper than the cauda and becomes wider ventrally than dorsally. It is twice as short as the narrower and posteriorly expanded, hooked and not clearly closed cauda. Both collicula are distinct and well separated. The cristae are salient; the superior one is more concave behind the ostium/cauda junction. The dorsal area shows a marked depression. There is no clear ventral furrow in the ventral area. The outer face is slightly concave with the maximum concavity in the anterior portion.

Remarks
The sulcus of the new species resembles otoliths of the family Ephippidae which are very scarce in the fossil record. Otoliths of *Ch. steurbauti* are most similar to the Recent species *Ch. lippei* STEINDACHNER, 1895 (see STINTON, 1984, p. 292, text-fig. 40b). They differ from the Recent species by the relatively shorter length, marked anterodorsal angle, deeper excisura and by slightly undulated rims. *Chaetodipterus* sp. from the Bartonian of the London Basin (STINTON, 1984, pl. 19, fig. 9) differs from the Spanish otoliths mainly in the markedly more expanded posterior angle. The two fossil otoliths from the Pamplona Marl are very well preserved. This is the reason to define the new species.

Pardachirus izarrae n. sp.
Pl. 4, Figs 10-12

Derivatio nominis
The name *izarrae* refers to the national Basque drink (Izarra) from the Pyrenean region.

Type material
Holotype: a right otolith (Pl. 4, Fig. 10) (IRSNB P 8886) and five paratypes of which two are figured (Pl. 4, Figs 11-12) (IRSNB 8887 – P 8888).

Dimension of the holotype
Length = 1.3 mm, Height = 1.4 mm, Thickness = 0.4 mm.

Stratum typicum
Basal Pamplona Marl at Yebra de Basa.

Description
Otoliths of this species are compact, generally oval with a truncated anteroventral rim and a salient anterodorsal angle. The height is greater than the length. In some specimens, the rims can be slightly undulated in the dorsal and anteroventral zone (Pl. 4, Fig. 11). The dorsal rim is usually straight with a sharp anterodorsal angle and broadly rounded posterodorsal angle. The straight anterior part of the dorsal rim runs obliquely towards the anterodorsal angle. There is some shallow concavity at the anterior margin, but no real excisura. The inner face is rather smooth and strongly convex in all directions. The elongated elliptical sulcus shows no clear division in ostial and caudal portion; the anterior part is deeper than the posterior one. A distinct and wide circumsulcal depression reaches close to the anterior rim, especially in small specimens (Pl. 4, Fig. 12). The outer face is entirely smooth and strongly convex, with the maximum convexity in the posterior portion.

Remarks
Otoliths of this genus are rare in the fossil record. *P. izzarae* differs from those of the Upper Oligocene-Lower Miocene *P. sulci* (STEURBAUT, 1984, pl. 35, figs 24-26), which are characterized by a strong convex outer face and a very important expansion of the posteroventral area. Otoliths of four Recent species of the genus *Pardachirus* are figured by SCHWARZHANS (1999, p. 331, figs 872-875).

Composition of the otolith-based fish fauna

Otoliths collected in the basal part of the Pamplona Marl at Yebra de Basa allow reconstituting a teleost fauna of 31 taxa, including 18 nominal species (Table 1). The assemblage is exceptional by its quantitative composition. A single species, *Apogon dominans* n. sp., dominates the association (92% of all otoliths; more than 5 000 specimens in the collection). Together with "genus aff. *Apogon*" *viaboadai* and *Rhynchoconger eocenicus,* they represent 98% of the association. The remaining twenty-eight taxa only represent two percent of all of the otoliths. Many apogonids are mainly reef-associated fishes, but may also be among the dominant fishes in Recent mangrove-coral habitats in several tropical regions (e.g. Gazi Bay and Tudor Creek, both in Kenya; see DE TROCH *et al.*, 1996; KIMANI *et al.*, 1996; VAN DER VELDE *et al.*, 1994). A similar environment at the initial phase of the Pamplona Marl sedimentation in the Yebra de Basa area may be considered.

The assemblage is composed mainly of benthic (demersal) fishes constituting 50% of all taxa (e.g. *Saurida, Onuxodon,* Antennariidae, *Apogon,* Holocentridae, *Platycephalus, Gazza, Pagrus, Cepola, Trachinus, Chaetodipterus* and Soleidae). This group is completed by eel-shaped fishes living mostly on the continental shelf and on the uppermost slope, or in the bottom mud (Congridae, Ophidiidae). This composition is typical for shallow Paleogene environments in tropical and subtropical seas with soft and muddy substrates (NOLF, 1985; GIRONE & NOLF, 2009). Two rare pelagic taxa (*Lactarius, Sphyraena*) are represented only by four otoliths.

Very shallow deposition conditions of the basal part of the Pamplona Marl near Yebra de Basa could also

Table 1 – Otolith-based fish taxa recorded in the basal Marls of Pamplona at the Yebra de Basa section.

Families	Represented taxa	Iconography	Number
Albulidae	*Albula* sp.	Pl. 1, Fig. 1	2
Ophichthyidae	"genus Nettastomatidarum" sp.	Pl. 1, Fig. 2	1
Congridae	*Rhynchoconger eocenicus* (SHEPHERD, 1916)	Pl. 1, Figs 5-7	119
	Rhynchoconger transversus (SULC, 1932)	Pl. 1, Figs 3-4	28
Clupeidae	*Chirocentrus* aff. *exilis* STINTON, 1977	Pl. 1, Figs 8-9	2
	Etrumeus sp.	Pl. 1, Figs 16-17	2
	genus "Clupeidarum" sp.	Pl. 1, Fig. 15	1
Synodontidae	*Saurida* sp.	Pl. 1, Fig. 10	3
Carapidae	*Onuxodon yebraensis* n. sp.	Pl. 2, Figs 1-4	6
Ophidiidae	*Glyptophidium polli* (CASIER, 1946)	Pl. 1, Figs 11-13	19
Antennariidae	Antennariidae gen. et sp. indet.	Pl. 1, Fig. 14	7
Berycidae	*Centroberyx* sp.	Pl. 2, Fig. 9	1
Holocentridae	Holocentridae gen. et sp. indet.	Pl. 2, Figs 10-11	3
Platycephalidae	*Platycephalus janeti* (PRIEM, 1911)	Pl. 2, Fig. 17	4
Serranidae	? Serranidae gen. et sp. indet.	Pl. 2, Fig. 8	1
Priacanthidae	*Pristigenys* aff. *rutoti* (LERICHE, 1905)	Pl. 2, Figs 6-7	2
Apogonidae	*Apogon dominans* n. sp.	Pl. 3, Figs 1-8	5.000
	"genus aff. *Apogon" viaboadai* n. sp.	Pl. 3, Figs 9-13	229
Lactariidae	*Lactarius amplus* STINTON, 1978	Pl. 2, Fig. 5	2
Carangidae	Carangidae gen. et sp. indet.	Pl. 4, Fig. 4	8
Menidae	*Mene iberica* n. sp.	Pl. 2, Figs 12-16	11
Leiognathidae	"genus aff. *Gazza*" *pentagonalis* NOLF & LAPIERRE, 1979	Pl. 3, Figs 14-15	3
Gerreidae	Gerreidae gen. et sp. indet.	Pl. 3, Fig. 16	1
Haemulidae	Haemulidae gen. et sp. indet.	Pl. 3, Figs 17-18	2
Sparidae	*Pagrus symmetricus* (FROST, 1934)	Pl. 4, Figs 5-6	3
Cepolidae	*Cepola* aff. *bartonensis* SCHUBERT 1916	Pl. 4, Fig. 1	1
Trachinidae	*Trachinus* aff. *falcatus* FROST, 1934	Pl. 4, Fig. 2	13
Sphyraenidae	*Sphyraena* cf. *fluctuosa* (NOLF, 1973)	Pl. 4, Fig. 3	2
Ephippidae	*Chaetodipterus steurbauti* n. sp.	Pl. 4, Figs 7-8	2
Soleidae	*Pardachirus izarrae* n. sp.	Pl. 4, Figs 10-12	6
	Solea sp.	Pl. 4, Figs 13-14	2

be proved by a paleobathymetric analysis of otoliths. Thirty percent of the represented taxa live today in the upper hundred meters; the genus *Onuxodon* and the genera *Chaetodipterus* and *Pardachirus* do not live deeper than 30 and 50 m respectively. All of the other genera of fishes represented in the Bartonian fauna of Yebra de Basa are inhabitants of the shelf or uppermost part of the continental slope, many of them with an inclination for very shallow water (e.g. *Platycephalus, Gazza, Saurida*). This picture is corroborated by the complete absence of mesopelagic and bathypelagic groups.

The present day climatic range of the fish taxa identified at Yebra de Basa points to a tropic to subtropic climate (4 taxa, antennariids, holocentrids, *Lactarius* and *Mene* are tropic and the others are tropic/subtropic today). Otoliths of taxa with a broader climatic range, e.g. tropic-subtropic-temperate, are scarce (*Centroberyx, Trachinus*).

An important number of genera, like *Onuxodon, Glyptophidium, Centroberyx, Platycephalus, Lactarius, Mene, Gazza* and *Pardachirus* have a present-day distribution pattern that is restricted to the Indo-Pacific realm. *Albula, Gnathophis, Rhynchoconger, Saurida,* Holocentridae, *Pristigenys* and *Chaetodipterus* constitute groups of fishes with broader geographic ranges, but are absent in the present day Mediterranean. Eight taxa (Nettastomatidae, *Apogon*, Haemulidae, *Pagrus, Cepola, Trachinus, Sphyraena* and *Solea*) can be also found in the modern Mediterranean fish fauna.

Paleobiogeographic and stratigraphic implications

Neritic Middle Eocene otolith associations are known mainly from Western Europe (Aquitaine Basin – NOLF, 1988; Bretagne – NOLF & LAPIERRE, 1976; London and Hampshire basins – STINTON, 1975-1984; Paris Basin – NOLF, 1972a; NOLF & CAPPETTA, 1976; NOLF & LAPIERRE, 1979; Belgian Basin - STINTON & NOLF, 1970; NOLF,1972b, c) and the Indian and South Asiatic realm (Pakistan) - NOLF, 1991; Western India – SAHNI & SAXENA, 1982; NOLF & BAJPAI, 1992; Java - NOLF & BAJPAI, 1992).

Among the 18 nominal species from Yebra de Basa, six are new and thus not yet known from any other place. Among the others (or their close relatives for the species cited as aff. or cf.), five are known from the Bartonian stratotype, four from the Lutetian-Priabonian

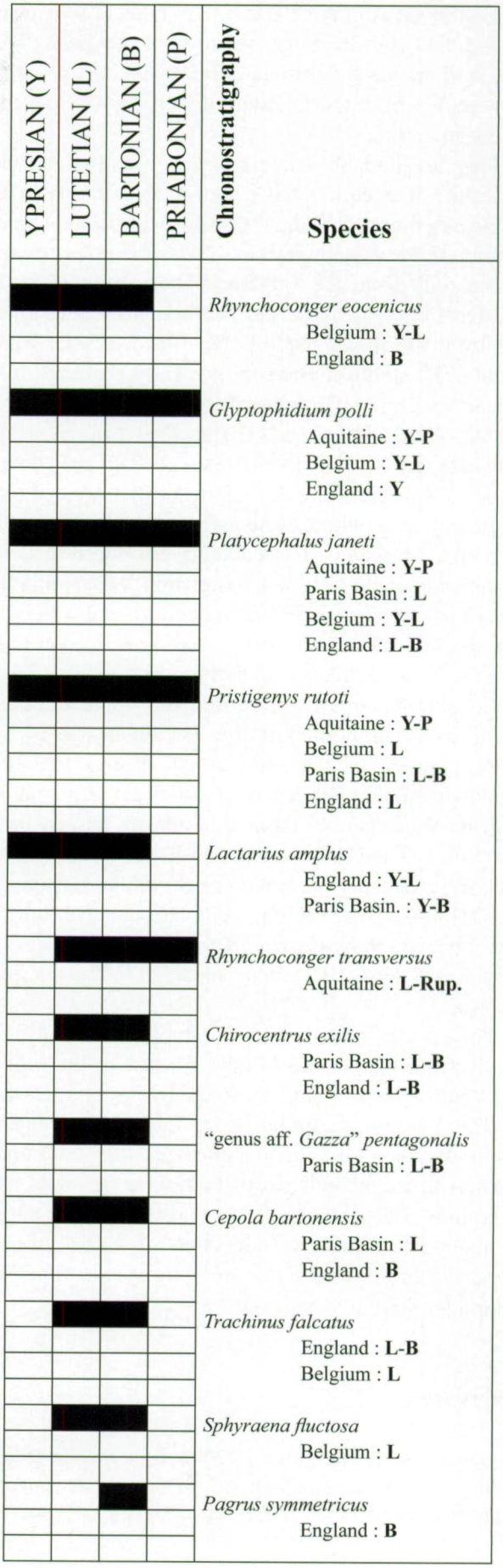

Table 2 – Nominal species of the Yebra de Basa section in common with other European Eocene basins.

interval in the Aquitaine Basin, SW France, four from the Lutetian-Bartonian interval of the Paris Basin, and one, *Sphyraena flexuosa* is a relatively rare species only known from the Lutetian of Belgium outside the Pyrenean realm.

This assemblage reflects a very shallow neritic environment and, logically, shows a similarity with otolith assemblages of the European Middle and Upper Eocene. In the Aquitaine Basin, Bartonian otoliths are known only from the very near shore Pédelail Beds (a lateral equivalent of the Brassempuy Limestone) and from the upper part of the Villa Marbella Marl in the cliffs south of Biarritz (presently immured in a concrete wall; samples equivalent to the samples 49-52 of MATHELIN, 1988 and MATHELIN & SZTRÁKOS, 1993 were taken by Nolf and Steurbaut in 2002). The Pedelail site is a very near shore deposit that only provided five species, among which were two juvenile apogonids. The Villa Marbella Marl contains essentially a deep neritic – upper slope otolith association, very similar to the one of the Priabonian Brihande Marl, and with only one species, *Rhynchoconger transversus*, in common with the Yebra de Basa association.

Concluding, one can say that the Yebra de Basa otolith association supports the Bartonian age of the deposit: seven of the represented species are also known from the Bartonian of Southern England or from the Paris Basin (Table 2). Four are known from both Lutetian and Priabonian deposits in Aquitaine and, thus, were virtually present there during the Bartonian. The Yebra de Basa otoliths complete our data on the Late Eocene ichthyofaunas of the Pyrenean realm by providing a neritic Bartonian fauna, including six new species.

The species pattern of the Pamplona Marl differs totally from that of the Middle Eocene in the Indian and South Asiatic realm. As stated by NOLF & BAJPAI (1992), a point of similarity for both European and South Asiatic otolith associations of this time span consists in the abundance of congrids, ophidiids and apogonids. This common feature is clearly emphasized in abundant otoliths of all three of these groups, especially of the strongly dominating apogonids in the Pamplona Marl at Yebra de Basa.

References

BARNOLAS, A. & GIL-PEÑA, I., 2001. Ejemplos de relleno sedimentario multiposódico en una cuenca de antepaís fragmentada: La Cuenca Surpirenaica. *Geológico y Minero,* **112** (3): 17-38.

BAUER, F.U., 2008. The Sabiñánigo Sandstone Succesion, Jaca Basin, Southern Pyrenees, NE-Spain. Institut of Geology and Paleontology, University of Heidelberg, 184 p., Heidelberg.

CAMPANA, S.E., 2004. Photographic atlas of fish otoliths of the nortwest Atlantic Ocean. *Canadian special publication of fisheries and Aquatic Sciences*, **133**: 1-284.

CANUDO, J.I. & MOLINA, E., 1988. Biocronologia con Foraminiferos planctonicos de la secuencia deposicional de Jaca (Pirineo Aragones): Eoceno medio y superior. *Comunicaciones Congresso Geológico de Españа,* **1**: 273-276.

DE TROCH, M., MEES, J., PAPADOPOULOS, I. & WAKWABI, E.O., 1996. Fish communities in a tropical bay (Gazi Bay, Kenya): seagrass beds vs. unvegetated areas. *Netherlands Journal of Zoology*, **46** (3-4): 236-252.

FRIZZEL, D.L. & LAMBER, K., 1962. Distinctive „Congrid type" fish otoliths from the Lower Tertiary of the Gulf Coast (Pisces: Anguilliformes). *Proceedings of the California Academy of Science, 4th series, G. Dallas Hanna Anniversary Volume*, **32** (5): 87-101.

FROESE, R. & PAULY, D. (eds), 2010. FishBase. World Wide Web electronic publication (www.fishbase.org, accessed July 2010).

GIRONE, A. & NOLF, D., 2009. Fish otoliths from the Priabonian (Late Eocene) of North Italy and South-East France – Their paleobiogeographical significance. *Revue de Micropaléontogie*, **52** (2009): 195-218.

KIMANI, E.N., MWATHA, G.K., WAKWABI, E.O., NTIBA, J.M. & OKOTH, B.K., 1996. Fishes of shallow tropical mangrove estuary, Gazi, Kenya. *Marine and Freshwater Research*, **47**: 857-868.

MATHELIN, J.C., 1988. Le Paléogène des falaises de Biarritz: révision biostratigraphique; paléoenvironnements et diapirisme. Thèse de doctorat 3e cycle, Université Pierre et Marie Curie, 159 pp.

MATHELIN, J.C. & SZTRÁKOS, K., 1993. L'Eocène de Biarritz (Pyrénées Atlantiques, SW France). Stratigraphie et paléoenvironnement. Monographie des foraminifères. *Cahiers de Micropaléontologie*, N.S., **8**: 5-182.

MÜLLER , A. & ROZENBERG, A., 2003. Teleostei-Otolithen aus den Mandrikovka-Schichten (Priabonium) von Dnepropetrovsk (Ukraine). *Paläontologische Zeitschrift*, **77** (2): 361-387.

NELSON, J.S., 2006. Fishes of the world. Fourth Edition. John Wiley & Sons, Inc., 601 p., New Jersey.

NOLF, D., 1972a. Deuxieme note sur les Téléostéens des Sables de Lede (Éocene Belge). *Bulletin de la Société Belge de Géologie, de Paléntologie et d'Hydrologie,* **81** (1-2): 95-109.

NOLF, D., 1972b. Sur la faune ichthyologique des Formations

du Panisel et de den Hoorn (Eocene Belge). *Bulletin de la Société Belge de Géologie, de Paléntologie et d'Hydrologie* **81** (1-2): 111-138.

NOLF, D., 1972c. Les otolithes du Calcaire Grossier a Fercourt (Eocene du Bassin de Paris). *Bulletin de la Société Belge de Géologie, de Paléntologie et d'Hydrologie,* **81** (1-2): 139-157.

NOLF, D., 1980. Etude monographique des otolithes des Ophidiiformes actuelles et revision des especes fossiles (Pisces, Teleostei). *Mededelingen Werkgroep Tertiaire en Kwartaire Geologie,* **17** (2): 71-195.

NOLF, D., 1985. Otolithi Piscium. *In*: SCHULTZE, H.-P. (ed.), Handbook of Paleoichthyology, 145 p., Gustav Fischer Verlag, Stuttgart.

NOLF, D., 1988. Les otolithes de téléostéens éocenes d'Aquitaine (sud-ouest de la France) et leur intéret stratigraphique. *Académie royale de Belgique, Mémoires de la classe des sciences, Collection in-4°-2° série*, **19** (2): 1-147.

NOLF, D. & BAJPAI, S., 1992. Marine Middle Eocene fish Otoliths from India and Java. *Bulletin de l'Institut royal des Sciences naturelles de Belgique, Science de la Terre,* **62**: 195-221.

NOLF, D. & CAPPETTA, H., 1976. Observations nouvelles sur les otolithes des Téléostéens du Calcaire Grossier (Eocene du Bassin de Paris). *Géobios*, **9** (3): 251-277.

NOLF, D. & LAPIERRE, H., 1976. Les otolithes de Téléostéens des Sables coquilliers du Bois-Gouet (Eocene de Bretagne). *Biologisch Jaarboek Dodonaea,* **44**: 256-268.

NOLF, D. & LAPIERRE, H., 1979. Otolithes de Poissons noveaux ou peu connus du Calcaire Grossier et de la Formation d'Auvers (Eocene du Bassin Parisien). *Bulletin du Museum National d'Histoire Naturelle, Paris*, **2**: 79-125.

NOLF, D., RANA, R. & SINGH, H., 2006. Fish otoliths from the Ypresian (early Eocene) of Vastan, Gujarat, India. *Bulletin de l'Institut royal des Sciences naturelles de Belgique, Sciences de la Terre*, **76**: 105-118.

OMS, O., DINARES–TURELL, J. & REMACHA, E., 2003. Magnetic stratigraphy from deep clastic turbidites: an example from the Eocene Hecho Group (Southern Pyrenees). *Studia Geophysica et Geodaetica,* **47** (2003): 275-288.

PUIGDEFABRIGAS, C., 1975. La sedimentation Molasica en la Cuenca de Jaca. *Monografias del Instituto de Estudios Pirenaicos*, **104**: 1-188.

QUÉRO, J.C., 2003. Guide des poissons de l'Atlantique européen. Delachaux et Niestlé S.A., Lonay (Switzerland), 465 p.

SCHWARZHANS, W., 1980. Die tertiäre Teleosteer-Fauna Neuseelands, rekonstruiert anhand von Otolithen. *Berliner Geowissenschaftliche Abhandlungen, A*, **26**: 1-211.

SCHELLART, W.P., 2002. Alpine deformation at the western termination of the Axial Zone, Southern Pyrenees. *In*: ROSENBAUM, G. & LISTER, G.S. (eds), Reconstruction of the Alpine Himalayan Orogene. *Journal of the Virtual Explorer*, **8**: 35-55.

SCHWARZHANS, W., 1977. Otolithen aud dem Unteroligozän (Tertiär) von Hückelhoven (Kreis Heinsberg, Nordrhein-Westfalen). *Decheniana (Bonn),* **130**: 268-292.

SCHWARZHANS, W., 1999. A comparative morphological treatise of recent and fossil otoliths of the order Pleuronectiformes. *Piscium Catalogus, Part Otolithi Piscium*, **2**: 1-391. Dr. Friedrich Pfeil Verlag. München.

SCHWARZHANS, W., 2010.The Otoliths from the Miocene of the North Sea Basin. Backhuys Publishers, Leiden, 352 p.

SCHWARZHANS, W. & BRATISHKO, A., in press. The otoliths from the middle Paleocene of Luzanivka, Cherkasy district, Ukraine. *Neues Jahrbuch für Geologie und Paläontologie.*

SERRA-KIEL, J., HOTTINGER, L., CAUS, E., DROBNE, K., FERRANDEZ, C., JAUHRI, A.K., LESS, G., PAVLOVEC, R., PIGNATTI, J., SAMSÓ, J.M., SCHAUB, H., SIREL, E., STRAUGO, A., TAMBAREAU, Y., TOSQUELLA, J. & ZAKREVSKAYA, E., 1998. Larger foraminiferal biostratigraphy of the Tethyan Paleocene and Eocene. *Bulletin Société géologique de France*, **169** (2): 281-99.

SMALE, M.J., WATSON, G. & HECHT, T., 1995. Otolith atlas of southern African fishes. *Ichthyological monographs, J.B. Smith Institute of Ichthyology,* **1**: 1-253

STEURBAUT, E., 1979. Les otolithes de Téléostéens des Marnes de Saubrigues (Miocéne d'Aquitaine méridionale, France). *Palaeontographica*, A, **166**: 50-91.

STEURBAUT, E., 1984. Les otolithes de Teleosteens de l'Oligo-Miocene d'Aquitaine (sud-ouest de la France). *Palaeontographica* A, **186**: 1-162.

STEURBAUT, E. & NOLF, D., 1990. Ypresian teleost otoliths from Belgium and northwestern France. *Bulletin de la Société belge de Géologie*, **97**-3/4 (1988): 321-347.

STINTON, F.C., 1977. Fish otoliths from the English Eocene, Part 2. *Palaeontographical monographs*: 57-126.

STINTON, F.C., 1984. Fish otoliths from the English Eocene, Part 5. *Palaeontographical monographs*: 259-320.

STINTON, F.C. & NOLF., D., 1970. A teleost otolith fauna from the Sands of Lede, Belgium. *Bulletin de la Société Belge de Géologie, de Paléontologie et d'Hydrologie*, **78** (1969): 219-234.

VAN DER VELDE, G., VAN AVESAATH, P.H., NTIBA, M.J., MWATHA, G.K., MARGUILLER, S. & WOITCHIK, A.F., 1994. Fish fauna of mangrove creeks, seagrss meadows and sand flats in Gazi Bay: a study with nets and stable isotopes. *In*: HEMMINGA, M.A., *Interlinkages between Eastern African Coastal ecosystems*. Second semi-annual report on the E.C.STD-3 project, pp. 28-37.

WEILER, W., 1942. Die Otolithen des rheinischen und nordwestdeutschen Tertiärs. *Abhandlungen des Reichsamts für Bodenforschung, Neue Folge*, **206**: 1-140.

Dirk NOLF
Institut royal des Sciences naturelles de Belgique
29 rue Vautier, 1000 Bruxelles, Belgique
e-mail: Dirk.Nolf@natuurwetenschappen.be

Rostislav BRZOBOHATÝ
Department of Geological Sciences
Masaryk University
Kotlářská 2, 61137 Brno, Czech Republic
e-mail: rosta@sci.muni.cz

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Explanation of the Plates

All figured specimens are deposited in the collections of the "Institut Royal des Sciences Naturelles de Belgique" (IRSNB). The fossil otoliths bear numbers of the collection of types and figured fossil fish specimens of the IRSNB. The Recent otoliths are part of the reference collection of Recent otoliths at the same institution. The latter collection is arranged in systematic order without numbering; therefore, such specimens, when figured, bear only the notation "coll. IRSNB". The abbreviations F and R in the upper right corner of each compartment of the plates indicate whether the figured specimens in that compartment are fossils (F) or Recent (R). Recent species occurring as fossils are labelled with ([F]). The annotations a, b and c are used to indicate respectively ventral, inner (= mesial) and posterior views. Figures with only numbers and no letter show inner views. In the captions, L stands for left otolith and R for right otolith.

PLATE 1

Fig. 1 — *Albula* sp., R (IRSNB P 8825).
Fig. 2 — „genus Nettastomatidarum" sp., R (IRSNB P 8826).
Figs 3-4 — *Rhynchoconger transversus* (SULC, 1932), 3 = R, 4 = L (IRSNB P 8827 – P 8828).
Figs 5-7 — *Rhynchoconger eocenicus* (SHEPHERD, 1916), R (IRSNB P 8829 – P 8831).
Figs 8-9 — *Chirocentrus* aff. *exilis* STINTON, 1977, L (IRSNB P 8832 – P 8833).
Fig. 10 — *Saurida* sp., L (IRSNB P 8834).
Figs 11-13 — *Glyptophidium polli* (CASIER, 1946), L (IRSNB P 8835 – P 8837).
Fig. 14 — Antennariidae gen. et sp. indet., R (IRSNB P 8838).
Fig. 15 — „genus Clupeidarum" sp., L (IRSNB P 8839).
Figs 16-17 — *Etrumeus* sp., 16 = L, 17 = R (IRSNB P 8840 – P 8841).

PLATE 2

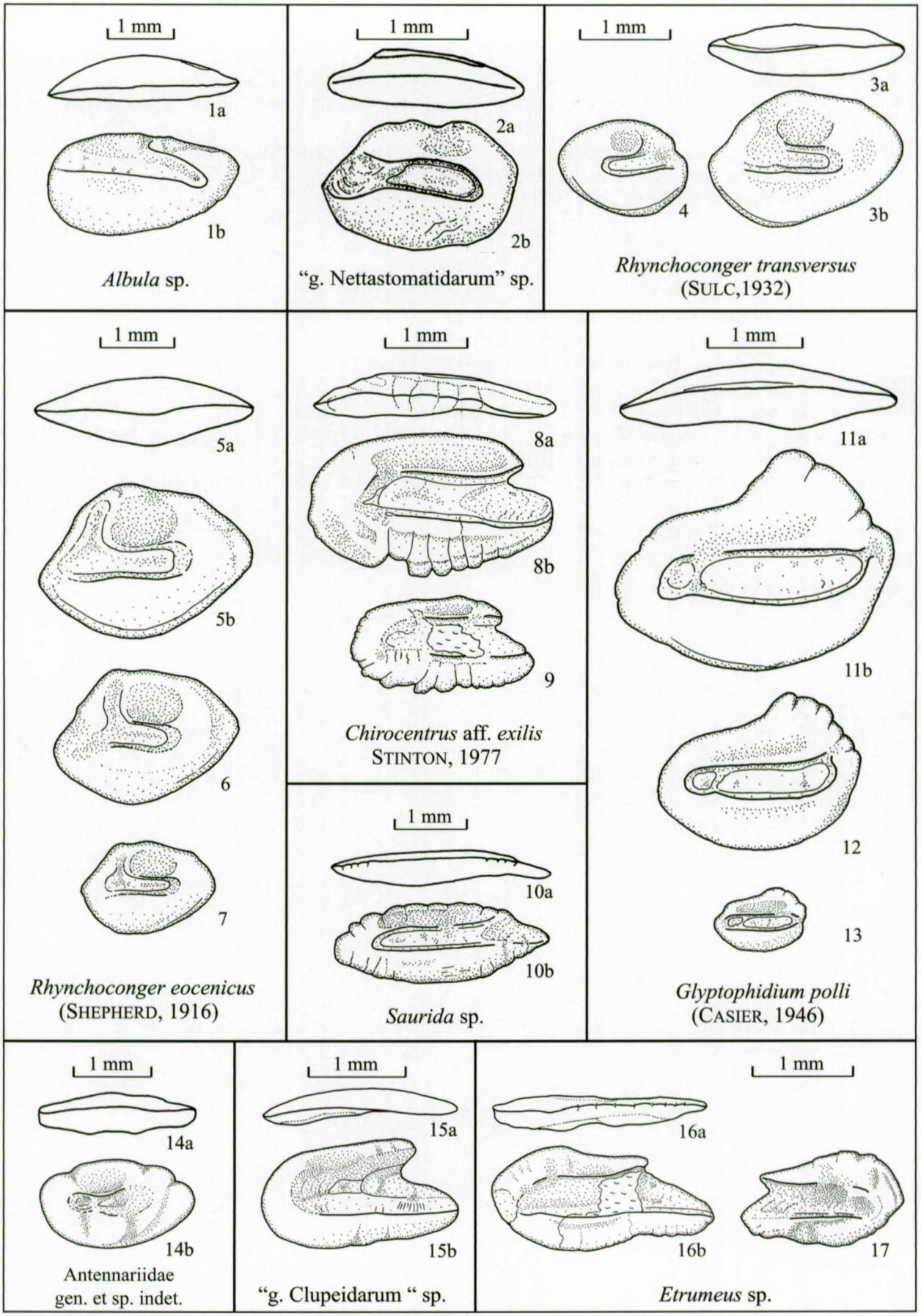
Figs 1-4 — *Onuxodon yebraensis* n. sp., 1 = holotype (IRSNB P 8842), L; 2-4 = paratypes, R (IRSNB P 8843 – P 8845).
Fig. 5 — *Lactarius amplus* STINTON, 1978, R (IRSNB P 8846).
Figs 6-7 — *Pristigenys* aff. *rutoti* (LERICHE, 1905), 6 = L, 7 = R (IRSNB P 8847 – P 8848).
Fig. 8 — ? Serranidae gen. et sp. indet., L (IRSNB P 8849).
Fig. 9 — *Centroberyx* sp., R (IRSNB P 8850).
Figs 10-11 — Holocentridae gen. et sp. indet., R (IRSNB P 8851 – P 8852).
Figs 12-16 — *Mene iberica* n. sp., 16 = holotype (IRSNB P 8853), R; 12-15 = paratypes, L (IRSNB P8854 – P 8857).
Fig. 17 — *Platycephalus janeti* (PRIEM, 1911), L (IRSNB P 8858).

PLATE 3

Figs 1-8 — *Apogon dominans* n.sp., 1 = holotype (IRSNB P 8859), L; 2-4 = paratypes, L; 5-8 = paratypes, R (IRSNB P 8860 – P 8866).
Figs 9-13 — „genus aff. *Apogon*" *viaboadai* n.sp., R, 9 = holotype (IRSNB P 8867), 10-13 = paratypes (IRSNB P 8868 – P 8871).
Figs 14-15 — „genus aff. *Gazza*" *pentagonalis* NOLF & LAPIERRE, 1979, L (IRSNB P 8872 – P 8873).
Fig. 16 — Gerreidae gen. et sp. indet., R (IRSNB P 8874).
Figs 17-18 — Haemulidae gen. et sp. indet., R (IRSNB P 8875 – P 8876).

PLATE 4

Fig. 1 — *Cepola* aff. *bartonensis* SCHUBERT, 1916, L (IRSNB P 8877).
Fig. 2 — *Trachinus* aff. *falcatus* FROST, 1934, L (IRSNB P 8878).
Fig. 3 — *Sphyraena* cf. *fluctuosa* (NOLF, 1973), R (IRSNB P 8879).
Fig. 4 — Carangidae gen. et sp. indet., R (IRSNB P 8880).
Figs 5-6 — *Pagrus symmetricus* (FROST, 1934), R (IRSNB P 8881– P 8882).
Figs 7-8 — *Chaetodipterus steurbauti* n.sp., L, 7 = holotype (IRSNB P 8883), 8 = paratype (IRSNB P 8884).
Fig. 9 — Haemulidae gen. et sp. indet., L (IRSNB P 8885).
Figs 10-12 — *Pardachirus izarrae* n. sp., R, 10 = holotype (IRSNB P 8886), 11-12 = paratypes (IRSNB P 8887 – P 8888).
Figs 13-14 — *Solea* sp., R (IRSNB P 8889 – P 8890).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"g. Nettastomatidarum" sp.
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4
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Rhynchoconger transversus
(SULC,1932)
1 mm
5a
5b
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7
Rhynchoconger eocenicus
(SHEPHERD, 1916)
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8a
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9
Chirocentrus aff. exilis
STINTON, 1977
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10a
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Saurida sp.
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13
Glyptophidium polli
(CASIER, 1946)
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Antennariidae
gen. et sp. indet.
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"g. Clupeidarum " sp.
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16a
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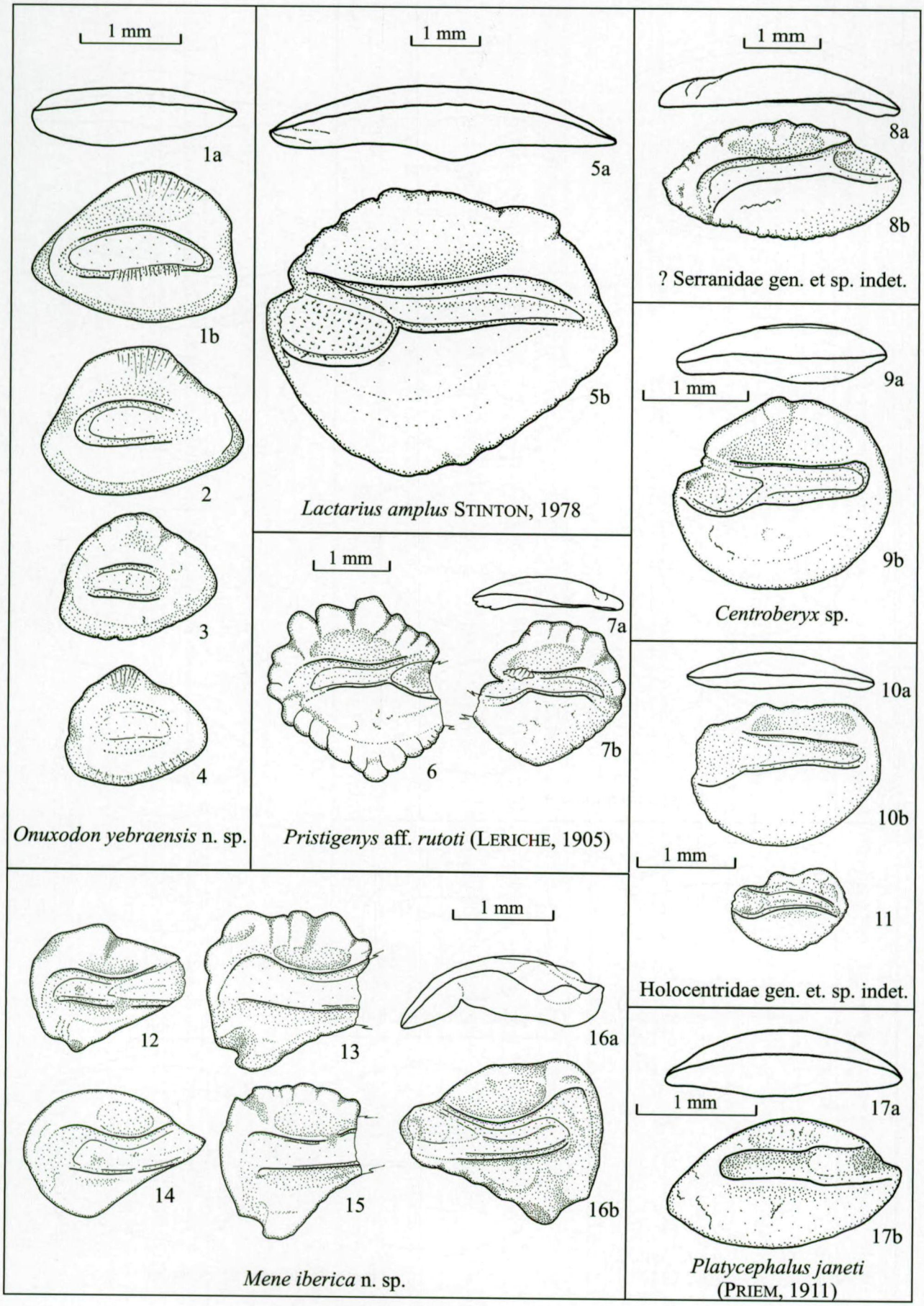
17
Etrumeus sp.

PLATE 1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Onuxodon yebraensis n. sp.
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Pristigenys aff. rutoti (LERICHE, 1905)
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8a
8b
? Serranidae gen. et sp. indet.
9a
1 mm
9b
Centroberyx sp.
10a
10b
1 mm
11
Holocentridae gen. et. sp. indet.
1 mm
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14
15
16a
16b
Mene iberica n. sp.
1 mm
17a
17b
Platycephalus janeti
(PRIEM, 1911)

PLATE 2

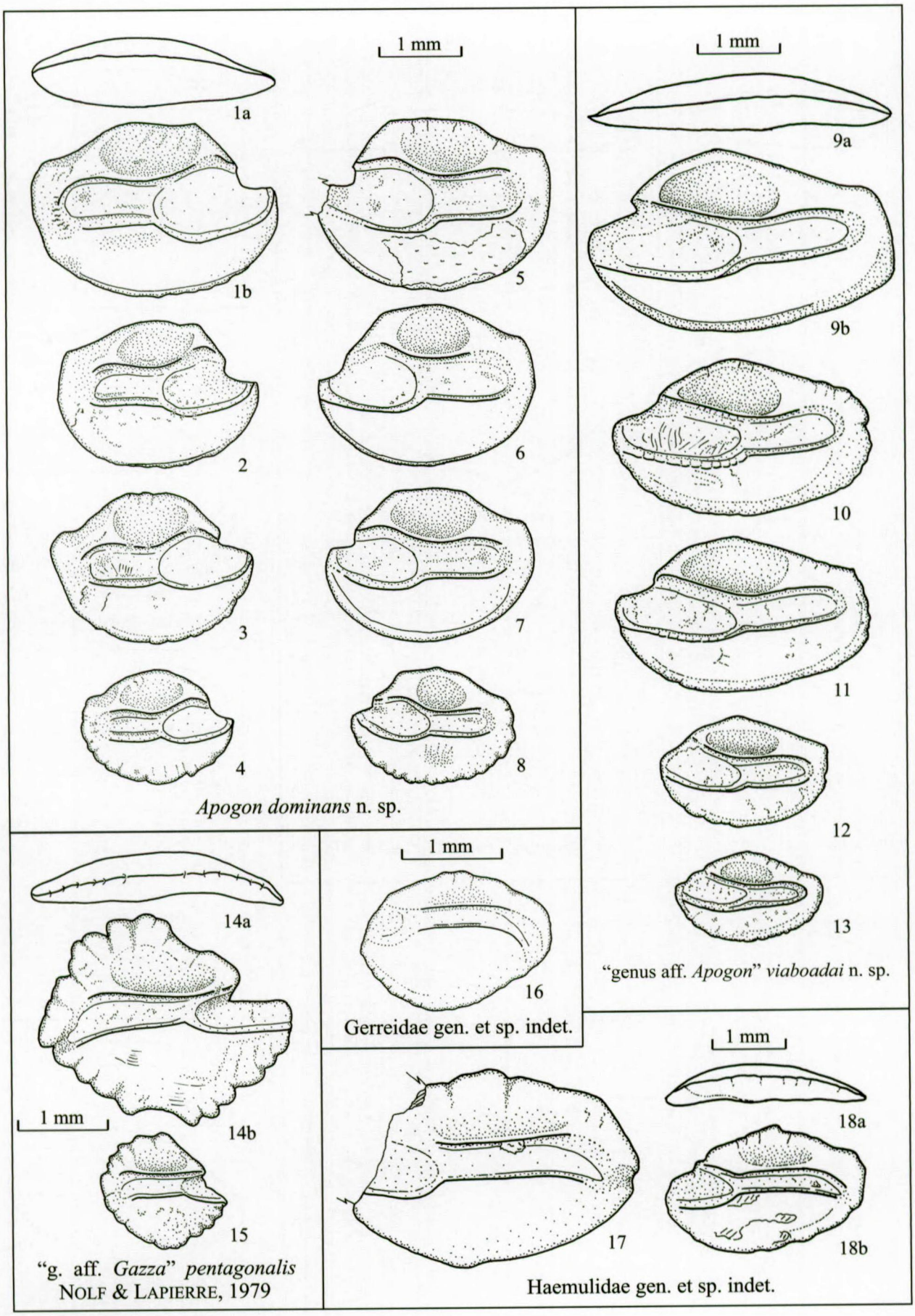
1 mm
1a
1b
2
3
4
5
6
7
8
Apogon dominans n. sp.
1 mm
9a
9b
10
11
12
13
"genus aff. Apogon" viaboadai n. sp.
1 mm
16
Gerreidae gen. et sp. indet.
14a
1 mm
14b
15
"g. aff. Gazza" pentagonalis
NOLF & LAPIERRE, 1979
1 mm
17
18a
18b
Haemulidae gen. et sp. indet.

PLATE 3

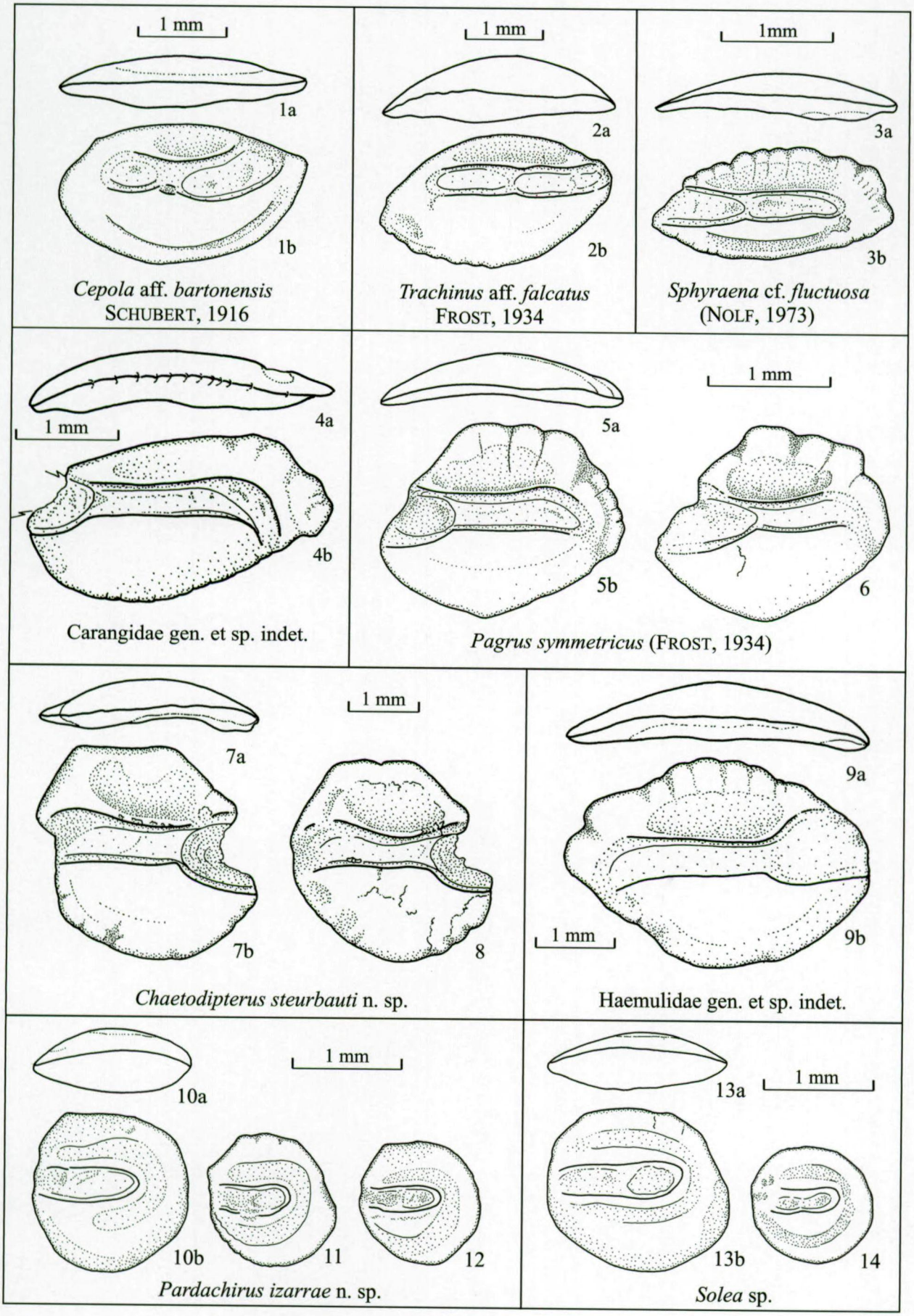
1 mm
1a
1b
Cepola aff. bartonensis
SCHUBERT, 1916
1 mm
2a
2b
Trachinus aff. falcatus
FROST, 1934
1mm
3a
3b
Sphyraena cf. fluctuosa
(NOLF, 1973)
1 mm
4a
4b
Carangidae gen. et sp. indet.
5a
5b
1 mm
6
Pagrus symmetricus (FROST, 1934)
1 mm
7a
7b
8
Chaetodipterus steurbauti n. sp.
9a
1 mm
9b
Haemulidae gen. et sp. indet.
1 mm
10a
10b
11
12
Pardachirus izarrae n. sp.
13a
1 mm
13b
14
Solea sp.

PLATE 4