

## Complement to the study of the Indian Paleocene osteoglossid fish genus *Taverneichthys* (Teleostei, Osteoglossomorpha)

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### Abstract

A series of osteological characters of *Taverneichthys bikanericus* from the continental Paleocene of India are studied, allowing specifying its systematic position within the Osteoglossidae. It is shown that on the basis of its peculiar snout morphology this species occupies an intermediate position between genera such as *Chanopsis* and *Phareodus*, which possess a primitive snout with a large dermethmoid reaching the frontals and separating the two nasals from each other, and such as *Brychaetus*, *Musperia*, *Opsithrissops*, *Osteoglossum* and *Scleropages*, which exhibit an evolved snout. The latter presents nasals, which are articulated to the frontals, meeting each other on the mid-line, except at their anterior edge, where a small dermethmoid, largely separated from the frontals, is inserted between.

**Keywords:** Teleostei, Osteoglossidae, Paleocene, *Taverneichthys*, osteology, relationships.

### Résumé

Les auteurs étudient quelques caractères ostéologiques de *Taverneichthys bikanericus* du Paléocène continental de l'Inde et précisent sa position systématique au sein des Osteoglossidae. Ils montrent que la morphologie particulière du museau de ce poisson le situe en position intermédiaire entre des genres tels que *Chanopsis* et *Phareodus* qui possèdent un museau primitif avec un grand dermethmoïde qui touche aux frontaux et sépare les deux nasaux l'un de l'autre, et tels que *Brychaetus*, *Musperia*, *Opsithrissops*, *Osteoglossum* et *Scleropages* qui présentent un museau évolué avec des nasaux articulés aux frontaux et jointifs sur presque toute leur longueur sauf à leur extrémité antérieure où un petit dermethmoïde, largement séparé des frontaux, s'intercale entre eux.

**Mots-clés:** Teleostei, Osteoglossidae, Paléocène, *Taverneichthys*, ostéologie, relations.

### Introduction

The super-order Osteoglossomorpha represents one of the more basal and more ancient lineages within the teleost fishes. It has a long paleontological history, which, in Asia, goes back as far as the Jurassic-Cretaceous boundary (CHANG & MIAO, 2004: 547), as evidenced by the lycoperid assemblage of China and Japan. The earliest osteoglossid representative in Africa is *Chanopsis lombardi* CASIER, 1961, known from the Lower Cretaceous (Valanginian/Barremian) deposits of the Democratic Republic of Congo. Fossil Osteoglossomorpha comprise both marine and fresh-water members. The group is represented today by twenty-five tropical fresh-water genera, including five Osteoglossoidei, four Notopteridae, fifteen Mormyridae and one Gymnarchidae.

Fossil Osteoglossomorpha are frequently occurring in the Upper Cretaceous to Middle Eocene beds of the Indian subcontinent, although essentially represented by squamules, complete scales and otoliths (HORA, 1938; GAYET & MEUNIER, 1983; GAYET *et al.*, 1984; JOLLY & LOYAL, 1985; PRASAD *et al.*, 1986; PRASAD, 1987a,b; GAYET, 1987; JOLLY & BAJPAI, 1988; RANA, 1988; RANA & KUMAR, 1990; NOLF *et al.*, 2008).

Recently, KUMAR *et al.* (2005) introduced *Taverneichthys bikanericus* gen. and sp. nov., a new member of the fossil osteoglossid teleost fauna from India. This new taxon, only known by a partial skull, was discovered in the upper part of the Paleocene Palana Formation, near Bikaner in western Rajasthan, western India (Fig. 1). The skull is re-studied here.

### Material and methods

The holotype and only known specimen (JNVU/GEOL/PAL 502) of *Taverneichthys bikanericus* is stored in the



Fig. 1 – Schematic map of India, with position of the type locality Bikaner.

collections of the Department of Geology in the Jai Narain Vyas University, Jodhpur, India. It comes from the Paleocene Palana Formation, the geology and stratigraphy of which was described by KUMAR *et al.* (2005). It is re-studied by the first author using a stereomicroscope Wild M5. The text-figures are made with a camera lucida.

### Systematic palaeontology

Division Teleostei MÜLLER, 1846  
 Superorder Osteoglossomorpha  
 GREENWOOD *et al.*, 1966  
 Order Osteoglossiformes BERG, 1940  
 Suborder Osteoglossoidei GREENWOOD *et al.*, 1966  
 Family Osteoglossidae BONAPARTE, 1832  
 Genus *Taverneichthys* KUMAR *et al.*, 2005

*Type species: Taverneichthys bikanericus* KUMAR *et al.*, 2005

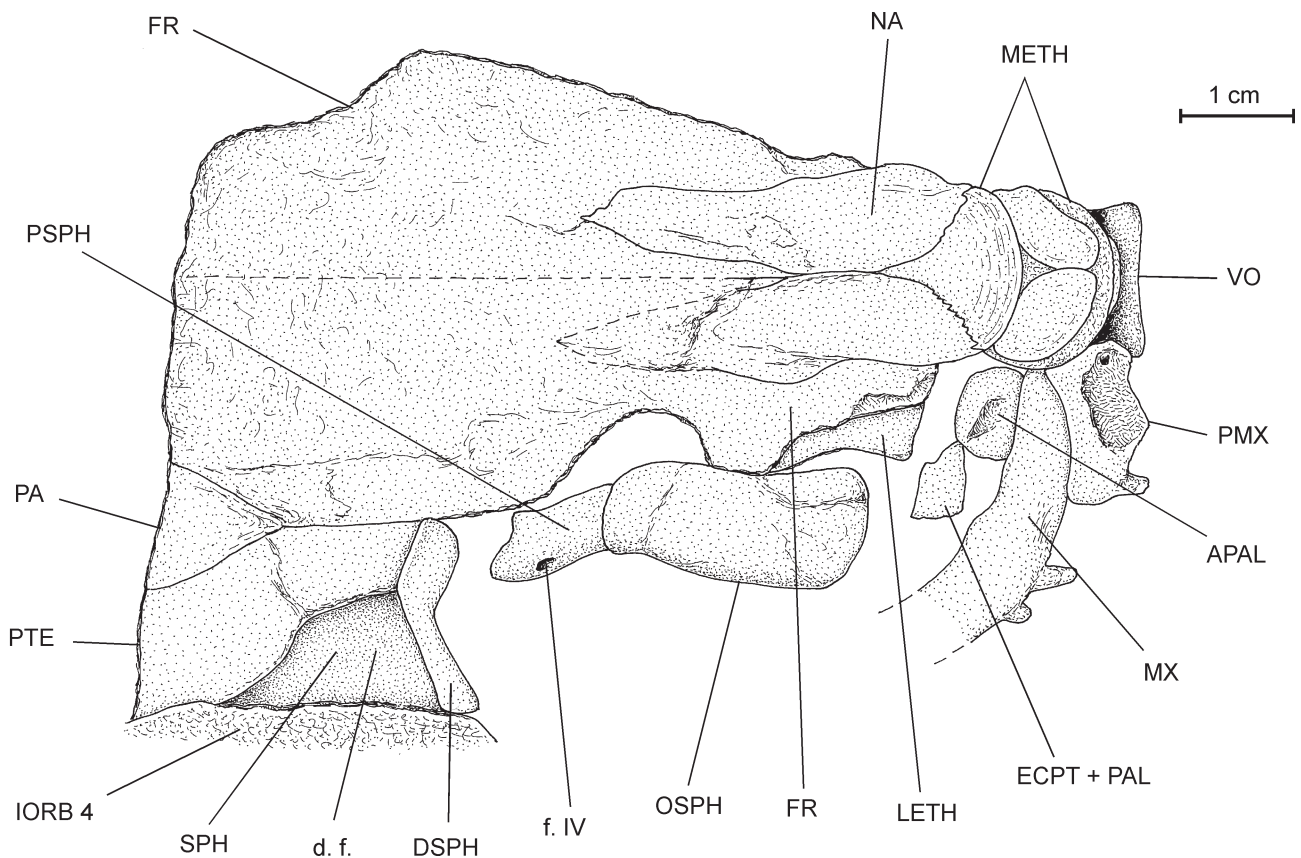


Fig. 2 – *Taverneichthys bikanericus* KUMAR *et al.*, 2005. The skull roof of the holotype.

*Taverneichthys bikanericus* KUMAR *et al.*, 2005

Figs 2-3

*Osteological remarks* (Figs 2-3)

The osteology described hereafter only concerns parts of the skull that was not or incompletely described previously. Therefore, it is very brief. For a more thorough description, see KUMAR *et al.* (2005).

The snout region is formed by an anterior complex mesethmoid, two posterior lateral ethmoids, paired nasals and a broad ventral toothed vomer. All the components of the mesethmoid are well preserved and clearly visible. The lateral ethmoid is present on the right side of the skull.

The mesethmoid endoskeleton contains four bones. Dorsally, there is a bulky supraethmoid, which is sutured ventrally with a narrower and higher hypoethmoid. This bone is conical in shape, with the apex ventrally directed, and is resting on a sort of wide bony cushion formed by a pair of fused small latero-basal ethmoids (= ethmopalatines), which are also fused with the dorsal surface of the vomer. Paired latero-basal ethmoids also occur in Notopteridae, Mormyridae and Gymnarchidae, three other osteoglossomorph families. In adult Notopteridae, they are fused with the hypoethmoid (TAVERNE, 1975: fig. 1, where those bones are called rhinals). The “vomer” of the Mormyridae is formed by the fusion of a pair of small latero-basal ethmoids, except in *Isichthys* GILL, 1862 and *Myomyrus* BOULENGER, 1898, where there is still a true vomer partially fused to the ventral surface of the pseudo-vomer (TAVERNE, 1972: figs 47, 62, 1974: fig. 1). In Gymnarchidae, the latero-basal ethmoids are fused into a large lamellar bone, which itself is partially fused to the hypoethmoid and the vomer (TAVERNE, 1976: fig. 1). The latero-basal ethmoids are very reduced and became fused with the hypoethmoid at a very young stage of development in Osteoglossidae (personal observations by L.T. on a juvenile specimen of *Osteoglossum* CUVIER, 1829). Within Arapaimidae, adult specimens of the genus *Heterotis* CUVIER & VALENCIENNES, 1846 still exhibit big latero-basal ethmoids, fused to the hypoethmoid and forming a pair of lateral condyles on which the premaxillae are articulated (TAVERNE, 1977: fig. 100).

Three plate-like dermal bones cover the entire dorsal surface of the supraethmoid and are fused with it. The posterior one, the rostrodermethmoid (= rostral), is the largest. It is a median bone fitted between the anterior extremities of the two nasals. This rostrodermethmoid is acuminate posteriorly, its anterior margin is broad and concave. A pair of ovoid lateral dermethmoids

occur more anteriorly. It is the first time that independent paired lateral dermethmoids are described in Osteoglossomorpha. These three dermal ethmoid bones are sometimes fused together to form a single piece of bone in rostrum-bearing osteoglossiformes. The lateral dermethmoids may completely disappear, leaving only the median rostrodermethmoid, or are captured by the ascending processes of the premaxillae, as it is the case with the median rostrodermethmoid in some specimens of the osteoglossoid taxon *Pantodon* PEETERS, 1876 (TAVERNE, 1978: fig. 35).

The jaws bear strong, tall and acuminate teeth. The premaxilla exhibits a short but broad ascending process, which is articulated with the mesethmoid.

Two large bones occur on the right side of the skull, below the frontal. The orbitosphenoid, located anteriorly, is much wider than the posteriorly positioned pleurosphenoid. Both reach the level of the parasphenoid and are located very laterally, showing that the orbitosphenoid is here a paired lateral bone and not an undivided median one as usual in teleosts, possessing such bones. The foramen for the pathetic nerve (IV) is visible on the pleurosphenoid.

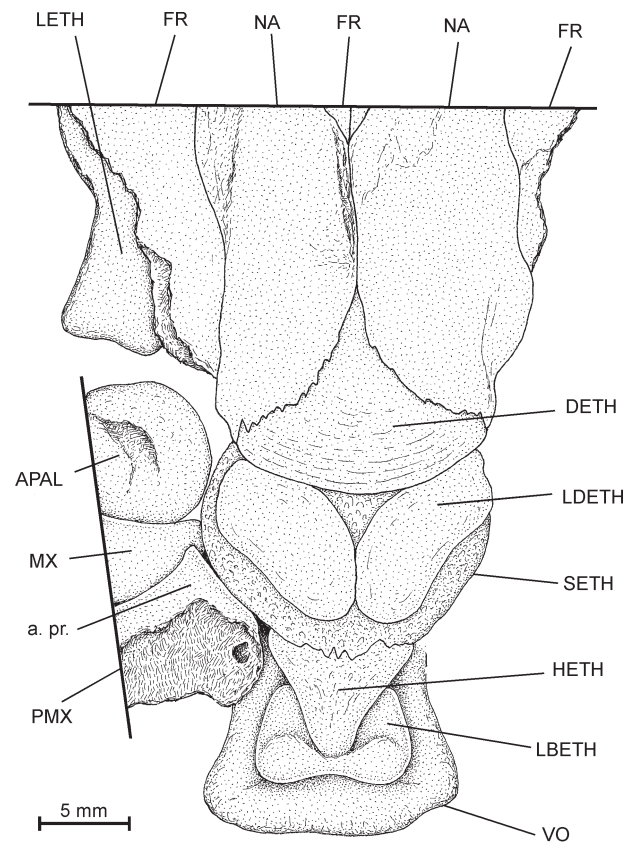


Fig. 3 – *Taverneichthys bikanericus* KUMAR *et al.*, 2005. The snout region of the holotype in antero-oblique view.

The skull roof is severely damaged and its posterior part is missing. A pair of wide, flat and long nasals, firmly articulated with the frontals, are present anteriorly. The posterior halves of the nasals are still separated by the frontals but the two bones meet on the mid-line in their middle parts, completely separating the frontals from the mesethmoid. The most anterior parts of the nasals are separated by the posterior sharp edge of the rostrodermethmoid. The frontals are long and broad bones but their lateral margins are broken on both sides of the braincase. So, it is not possible to determine their exact lateral expansion. However, when complete, the anterior half of the frontals was at least as wide as the posterior half and probably even wider in such a way that it was able to cover dorsally the laterally located orbitosphenoid. Each frontal exhibits an antero-lateral branch running along the lateral margin of the nasal. The triangular antero-lateral corner of the right parietal is visible behind the frontal and above the pterotic. A great part of the right pterotic is preserved. Its surface does not present any trace of a gutter for a mucous canal. There is a large and deep *dilatator fossa* resting on the dorsal surface of the sphenotic and partly covered by the pterotic. The lateral temporal fossa is not preserved.

A more or less spherical autogenous autopalatine is preserved near the mesethmoid and just above the anterior tip of the maxilla on which it is resting. The presence of an ossified autopalatine is exceptional within Osteoglossomorpha and only known in big specimens of *Scleropages* GÜNTHER, 1864 and *Heterotis* CUVIER & VALENCIENNES, 1846 (TAVERNE, 1977: figs 77, 101). The dermopalatine and the ectopterygoid are fused and toothed in the same way as in the entopterygoid. The metapterygoid is large. A fragment of the quadrate is preserved.

The two posterior infraorbitals are very large. The superior one is huge and much higher than broad. The dermosphenotic is rod-like, although a little narrower in its inferior half.

A part of the preopercle is visible, showing that its ventral branch is short.

The shape of the head and its height in the posterior frontal region indicate that *Taverneichthys bikanericus* was a deep-bodied fish.

## Discussion

KUMAR *et al.* (2005) introduced the new genus *Taverneichthys* on the basis of substantial differences between its skull and that of the other fossil

osteoglossid genera. They also briefly discussed its relationships within the Osteoglossidae and concluded that *Taverneichthys* is more evolved than *Phareodus* LEIDY, 1873 and more closely related to *Brychaetus* WOODWARD, 1901, *Musperia* SANDERS, 1934 and *Opsithrissops* DANILCHENKO, 1968.

The two huge posterior infraorbitals covering entirely the cheek, the large pointed teeth on the jaws, the shape of the premaxillae, the anteriorly wide frontals and the short ventral branch of the preopercle are characteristic of the Osteoglossidae. The presence of large paired orbitosphenoids reaching the floor of the braincase, the deep *dilatator fossa* supported by the sphenotic and partly covered by the pterotic, the two posterior infraorbitals located behind the level of the jaws, the rod-like dermosphenotic and the deep body place the Indian osteoglossid *Taverneichthys* away from the Recent genera *Osteoglossum* and *Scleropages* and bring it nearer to some fossil osteoglossid genera such as *Phareodus*, *Musperia*, *Brychaetus* or *Monopteros* VOLTA, 1796.

TAVERNE (1998: fig. 20; 2009) showed that two different snout patterns exist within the Osteoglossidae. The primitive pattern is exemplified by *Chanopsis* and *Phareodus*. In these genera, the wide nasals contact the frontals, but are separated from each other by a large rostrodermethmoid, embedded in a “V”-shaped notch formed by the anterior edge of the two frontals (Fig. 4A). The specialized pattern occurs in *Brychaetus*, *Musperia*, *Opsithrissops*, *Osteoglossum* and *Scleropages* among others. In these genera, the wide nasals, articulated with the frontals, meet on the mid-line along almost their entire length, except at their anterior extremities where a small rostrodermethmoid, largely separated from the frontals, is inserted between them (Fig. 4C). In *Taverneichthys*, the nasals, articulated with the frontals, meet each other in the mid-line only on their middle portions. They are also separated anteriorly by a large rostrodermethmoid and posteriorly by the frontals, and there is no contact between the rostrodermethmoid and the frontals (Fig. 4B). That is exactly the intermediate osteological situation between the primitive and advanced snout patterns. In the phylogenetic tree of the Osteoglossidae, such a character places *Taverneichthys* in an apomorphic position in regard to the osteoglossid genera with the archaic snout architecture, as *Chanopsis* and *Phareodus*, and in a plesiomorphic position relatively to the osteoglossid genera with the specialized snout morphology, as *Brychaetus*, *Musperia*, *Opsithrissops*, *Osteoglossum* and *Scleropages*.

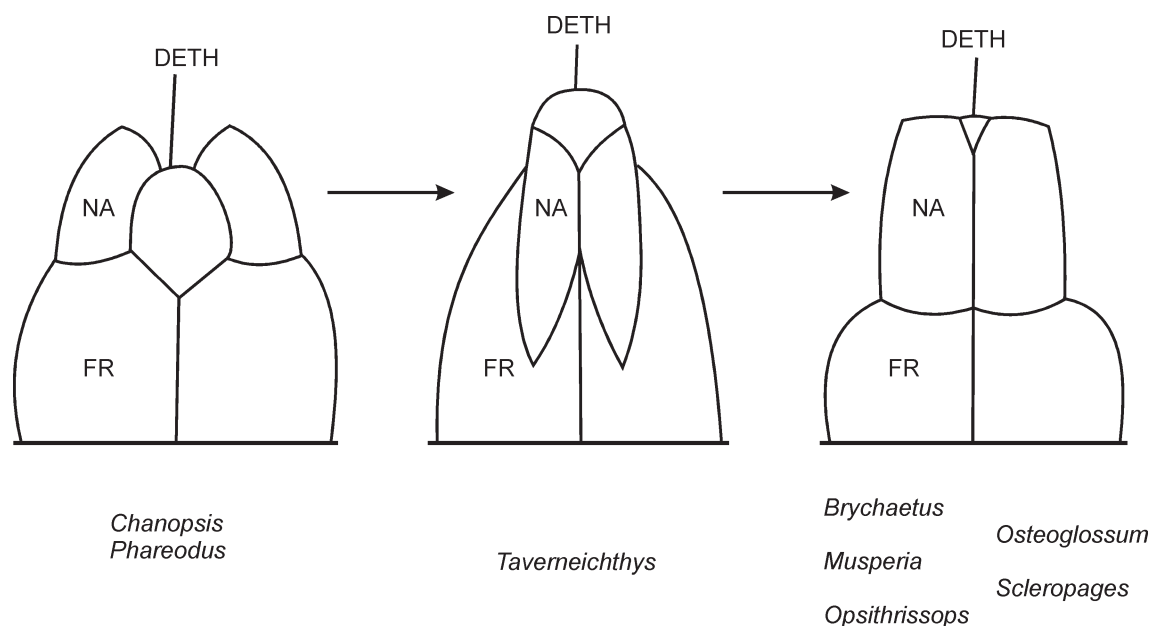


Fig. 4 – The evolution of the snout pattern within the Osteoglossidae, showing the intermediate position of *Taverneichthys bikanericus* KUMAR *et al.*, 2005.

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## List of the abbreviations used in the text-figures

APAL: autopalatine  
 DETH: rostrodermethmoid (= rostral)  
 DSPH: dermosphenotic  
 FR: frontal  
 ECPT + PAL: ectopterygoid + dermopalatine  
 HETH: hypoethmoid  
 IORB 4: fourth infraorbital  
 LBETH: latero-basal ethmoid (= ethmopalatine)  
 LDETH: lateral dermethmoid  
 LETH: lateral ethmoid  
 METH: mesethmoid  
 MX: maxilla  
 NA: nasal  
 OSPH: orbitosphenoid  
 PA: parietal  
 PMX: premaxilla  
 PSPH: pleurosphenoid (= pterosphenoid)  
 PTE: pterotic  
 SETH: supraethmoid  
 SPH: sphenotic (= autosphenotic)  
 VO: vomer

a. pr.: ascending process of the premaxilla  
 d. f.: *dilatator fossa*  
 f. IV: foramen for the pathetic (= trochlear) nerve (IV)

## References

- CHANG, M. & MIAO, D., 2004. An overview of Mesozoic fishes in Asia. *In*: ARRATIA, G. & TINTORI, A. (editors), *Mesozoic Fishes 3 – Systematics, Paleoenvironments and Biodiversity*, Verlag Dr. Friedrich PFEIL, München: 535-563.
- GAYET, M., 1987. Lower vertebrates from the Early-Middle Eocene Kuldana Formation of Kohat (Pakistan): Holostei and Teleostei. *Contributions from the Museum of Paleontology, University of Michigan*, **27**: 151-168.
- GAYET, M. & MEUNIER, F. J., 1983. Écailles actuelles et fossiles d'Osteoglossiformes (Pisces, Teleostei). *Comptes rendus de l'Académie des Sciences, Paris, II*, **297**: 539-542.
- GAYET, M., RAGE J.-C. & RANA, R. S., 1984. Nouvelles ichthyofaune et herpétofaune de Gitti Khadan, le plus ancien gisement connu du Deccan (Crétacé/Paléocène) à microvertébrés. Implications paléogéographiques. *Mémoires de la Société géologique de France, nouvelle série*, **147**: 55-63.
- HORA, S. L., 1938. On some fossil fish-scales from the Inter-Trappean beds at Deothan and Kheri, Central Provinces. *Records of the Geological Survey of India*, **73**: 267-294.
- JOLLY, A. & BAJPAI, S., 1988. Fossil Osteoglossidae from

- the Kalakot Zone (Middle Eocene): Implications for palaeoecology, palaeobiogeography and correlation. *Bulletin of the Indian Geologists' Association*, **21** (1): 71-79.
- JOLLY, A. & LOYAL, R. S., 1985. Record of microvertebrates from the Middle Eocene Marh Stage of Sri Kolayat, Rajasthan. *Bulletin of the Geological, Mining and Metallurgical Society of India*, **52**: 374-384.
- KUMAR, K., RANA, R. S. & PALIWAL, B. S., 2005. Osteoglossid and lepidosteid fish remains from the Paleocene Palana Formation, Rajasthan, India. *Palaeontology*, **48** (6): 1187-1209.
- NOLF, D., RANA, R. S. & PRASAD, G. V. R., 2008. Late Cretaceous (Maastrichtian) fish otoliths from the Deccan Intertrappean Beds, India: a revision. *Bulletin de l'Institut royal des Sciences naturelles de Belgique, Sciences de la Terre*, **78** : 239-259.
- PRASAD, G. V. R., 1987a. Fossil fish remains from the Intertrappean Beds of Duddukuru, Andhra Pradesh. *Bulletin of the Indian Geologists' Association*, **20** (2): 33-39.
- PRASAD, G. V. R., 1987b. Squamules of osteoglossid fish from the Intertrappean Beds of Pargi, Andhra Pradesh. *Current Science*, **56** (24): 1270-1272.
- PRASAD, G. V. R., SAHNI, A. & GUPTA, V. J., 1986. Fossil assemblages from Infra- and Intertrappean beds of Asifabad, Andhra Pradesh and their geological implications. *Geoscience Journal*, **7** (2): 163-180.
- RANA, R. S., 1988. Freshwater fish otoliths from the Deccan Trap associated sedimentary (Cretaceous-Tertiary transition) beds of Rangapur, Hyderabad District, Andhra Pradesh, India, *Geobios*, **21** (4): 465-493.
- RANA, R. S. & KUMAR, K., 1990. Late Cretaceous-Early Tertiary fish assemblages from Indian peninsular and Himalayan regions: comments on phylogeny and palaeobiogeography. In: SAHNI, A & JOLLY, A. (editors), Cretaceous event stratigraphy and the correlation of Indian nonmarine strata, Contribution from the Seminar cum Workshop, IGCP 216 and 245, Chandigarh: 55-57.
- TAVERNE, L., 1972. Ostéologie des genres *Mormyrus* Linné, *Mormyrops* Müller, *Hyperopisus* Gill, *Isichthys* Gill, *Myomyrus* Boulenger, *Stomatorhinus* Boulenger et *Gymnarchus* Cuvier. Considérations générales sur la systématique des poissons de l'ordre des Mormyriiformes. *Annales du Musée Royal de l'Afrique Centrale, Sciences Zoologiques*, série in-8°, **200**: 1-194.
- TAVERNE, L. 1974. Sur le « vomer » des Mormyridae et l'ethmoïde latéro-basal des Ichthyodectiformes (Pisces Ostéoglossomorphes). *Revue de Zoologie Africaine*, **88** (4): 837-842.
- TAVERNE, L., 1975. Deuxième note sur l'ethmoïde latéro-basal des poissons ostéoglossomorphes et son homologie avec le rhinal des holostéens à la lumière du cas des Notopteridae. *Revue de Zoologie Africaine*, **89** (3): 629-634.
- TAVERNE, L., 1976. Le rhinal (ethmoïde latéro-basal) de l'ostéoglossomorphe africain *Gymnarchus niloticus* (Pisces, Mormyriiformes). *Revue de Zoologie Africaine*, **90** (1): 14-16.
- TAVERNE, L., 1977. Ostéologie, phylogénèse et systématique des téléostéens fossiles et actuels du super-ordre des ostéoglossomorphes. Première partie. Ostéologie des genres *Hiodon*, *Eohiodon*, *Lycoptera*, *Osteoglossum*, *Scleropages*, *Heterotis* et *Arapaima*. *Académie Royale de Belgique, Mémoires de la classe des Sciences*, collection in-8°, 2<sup>e</sup> série, **42** (3): 1-235.
- TAVERNE, L., 1978. Ostéologie, phylogénèse et systématique des téléostéens fossiles et actuels du super-ordre des ostéoglossomorphes. Deuxième partie. Ostéologie des genres *Phareodus*, *Phareoides*, *Brychaetus*, *Musperia*, *Pantodon*, *Singida*, *Notopterus*, *Xenomystus* et *Papyrocranus*. *Académie Royale de Belgique, Mémoires de la Classe des Sciences*, collection in-8°, 2<sup>e</sup> série, **42** (6): 1-213.
- TAVERNE, L., 1998. Les ostéoglossomorphes marins de l'Éocène du Monte Bolca (Italie): *Monopteros* VOLTA, 1796, *Thrissopterus* HECKEL, 1856 et *Foreyichthys* TAVERNE, 1979. Considérations sur la phylogénèse des téléostéens ostéoglossomorphes. In: Studi e Ricerche sui Giacimenti Terziari di Bolca, 7, Museo Civico di Storia Naturale di Verona: 67-158.
- TAVERNE, L. 2009. New insights on the osteology and taxonomy of the osteoglossid fishes *Phareodus*, *Brychaetus* and *Musperia* (Teleostei, Osteoglossomorpha). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre*, **79**: 175-190. (this volume)

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