Geo-Eco-Trop., 2015, 39, 2 : 247-254

On the presence of a second osteoglossid fish (Teleostei, Osteoglossiformes) in the continental Lower Cretaceous of the Democratic Republic of Congo (Central Africa)

Sur la présence d'un second poisson ostéoglossidé (Teleostei, Osteoglossiformes) dans le Crétacé inférieur continental de la République Démocratique du Congo (Afrique centrale)

Louis TAVERNE [1]

Résumé: Un hyomandibulaire de téléostéen découvert dans les couches de la Formation de la Loia (Aptien-Albien continental) à Yakoko, sur la rivière Lomami, Province Centrale, République Démocratique du Congo, est décrit et ses relations phylogénétiques sont discutées. L'os est grand et porte un processus operculaire très allongé. Des comparaisons avec d'autres téléostéens du Crétacé inférieur continental indiquent que cet hyomandibulaire appartient à un ostéoglossidé qui semble proche de *Paralycoptera*.

Mots-clés: Teleostei, Osteoglossidae, hyomandibulaire, Formation de la Loia, Crétacé inférieur continental, Yakoko, République Démocratique du Congo

Abstract: A teleost hyomandibula discovered in the deposits of the Loia Formation (continental Aptian-Albian) at Yakoko, on the Lomami River, Central Province, Democratic Republic of Congo, is described and its phylogenetic relationships are discussed. The bone is rather large and bears an extremely long opercular process. Comparisons with other freshwater Early Cretaceous teleosts indicate that this hyomandibula belongs to an osteoglossid fish that seems close to *Paralycoptera*.

Key words: Teleostei, Osteoglossidae, hyomandibula, Loia Formation, continental Early Cretaceous, Yakoko, Democratic Republic of Congo.

INTRODUCTION

The Loia and the Bokungu Formations are respectively the lower and the upper strata within the continental Early Cretaceous deposits of the Congolese Cuvette and the surrounding zones, in the Democratic Republic of Congo (CAHEN *et al.*, 1959, 1960; CASIER, 1961). The Loia Formation is composed of red and green sandstones with some thin layers of bituminous shales and is reported to the Aptian-Albian, while the Bokungu Formation is made of red sandstones and shales and is reported to the Albian and eventually the Early Cenomanian (CAHEN *et al.*, 1959, 1960; CASIER, 1961; LEPERSONNE, 1977; COLIN, 1994).

The rather poor fossil ichthyofauna of both geological formations is represented by fragmentary and badly preserved material, a few teeth and spines of Selachii, some cranial bones of Crossopterygii, one tooth of Dipnoi, two vertebrae of Lepisosteidae, one tooth of Pycnodontidae, teeth and vertebrae of an ichthyodectid fish and three small Euteleostei (CASIER, 1961, 1969, TAVERNE, 1975). The most interesting discovery undoubtedly is *Chanopsis lombardi* CASIER, 1961, a large primitive osteoglossid teleost, probably reaching around 1 meter in length, and which is known by a complete skull roof, some other cranial and pectoral bones, ribs, vertebrae, a caudal skeleton and a few scales (CASIER, 1961; TAVERNE, 1984, 2016).

[1] Royal Institute of Natural Sciences of Belgium, Directorate Earth and History of Life, Vautierstreet, 29, B-1000 Brussels, Belgium. E-mail: louis.taverne@gmail.com

The aim of the present paper is to study the morphology and to discuss the relationships of an isolated hyomandibula found in the deposits of the Loia Formation, at Yakoko, on the Lomami River, Central Province, Democratic Republic of Congo (Fig. 1). This interesting piece was mentioned by CASIER (1961: 70) but not described.

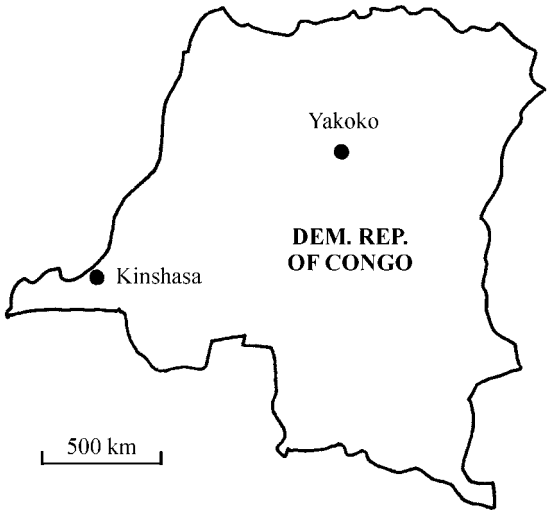

Figure 1: Location of Yakoko, Central Province, Democratic Republic of Congo.

MATERIAL AND METHODS

The specimen hereafter studied belongs to the paleontological collection of the Department of Geology of the Royal Museum for Middle Africa (MRAC), Tervuren, Belgium. The material was observed with a Leica MZ8 stereomicroscope. The drawings of the figures 3 and 4 were made by the author with a camera lucida and the photo of figure 2 by M. Stéphane HANOT, from the MRAC.

List of abbreviations used in the text-figures

HYOM	=	hyomandibula
art. h.	=	articular head
f. t. h. VII	=	foramen for the *truncus hyoideomandibularis* of the facial nerve (VII)
op. pr.	=	opercular process
v. br.	=	ventral branch

SYSTEMATIC PALEONTOLOGY

Division Teleostei MÜLLER, 1845
Superorder Osteoglossomorpha GREENWOOD *et al.*, 1966
Order Osteoglossiformes BERG, 1940
Suborder Osteoglossoidei REGAN, 1909
Family Osteoglossidae BONAPARTE, 1832

Genus and species *incertae sedis*

Specimen

MRAC RG 76, a large isolated hyomandibula (Figs 2, 3).

Formation and locality

Loia Formation, continental Aptian-Albian (Early Cretaceous), Yakoko, on the Lomami River, Oriental Province, Democratic Republic of Congo (Fig. 1).

Description (Figs 2, 3)

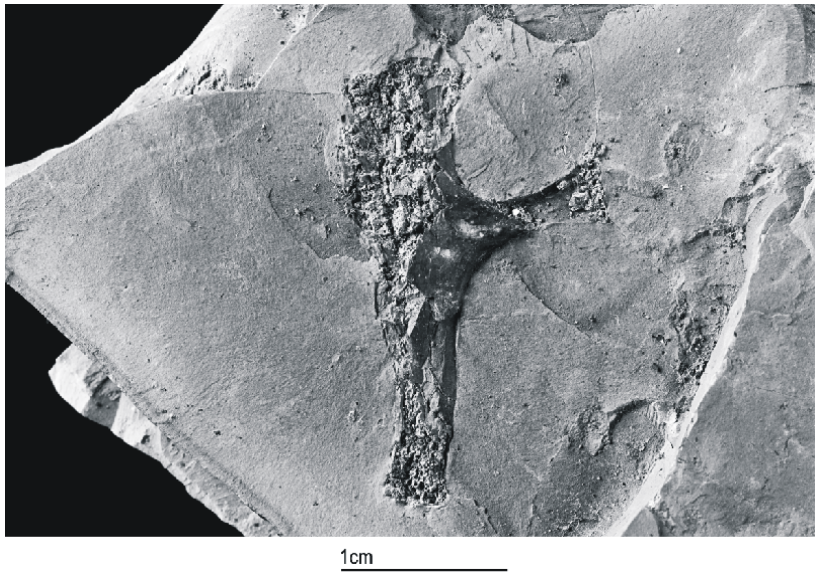

Figure 2: Sample MRAC RG 76. An isolated hyomandibular from the Loia Formation, Yakoko, on the Lomami River, Central Province, Democratic Republic of Congo.

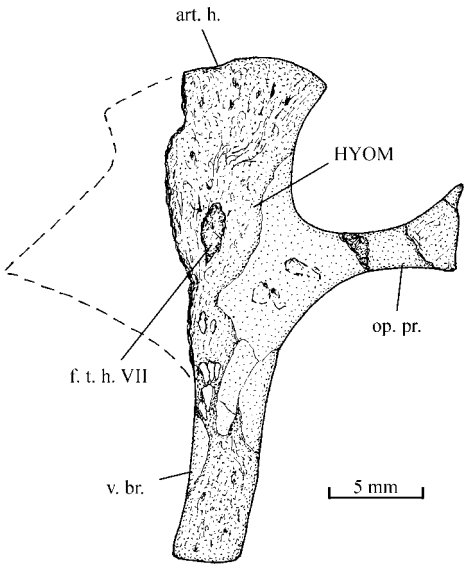

Figure 3: Sample MRAC RG 76. An isolated hyomandibula from the Loia Formation, Yakoko, on the Lomami River, Central Province, Democratic Republic of Congo.

The concerned hyomandibula belongs to a moderately large fish, the bone being 28 mm high. The upper region seems broad but its anterior half is lost, due to an artefact of fossilisation. The anterior bony wing also is missing. The preserved part of the articular head indicates that the upper margin of the bone is slightly divided, forming two feebly marked condyles. The ventral branch is broad, rod-like, moderately long (18 mm) and not enlarged at its ventral extremity. The opercular process is extremely elongated (10 mm) and slightly enlarged at is posterior border. This opercular

process and the posterior margin of the broadened upper region of the bone form a straight angle, whereas the process and the ventral branch form a slightly obtuse angle. On the middle region of the bone, at the level of the opercular process, there is a trace of the foramen for the *truncus hyoideomandibularis* of the facial nerve (VII). This foramen is rather small and deeper than broad.

DISCUSSION

Hyomandibulae bearing a very long opercular process are extremely unusual within Teleostei. Among the teleost families that already exist during the Lower Cretaceous, the occurrence of this character is only known in three of them, the Hiodontidae, the Notopteridae and the Osteoglossidae, three lineages belonging to the Osteoglossomorpha, one of the most basal teleost assemblage. This superorder has a worldwide distribution, except in Antarctica. It is still present today in North and South America, Africa, Asia and Australia but is also recorded as fossil in Europe (TAVERNE, 1998; BONDE, 2008; WILSON & MURRAY, 2008). All the recent members of the lineage are freshwater fishes but some fossil species are marine.

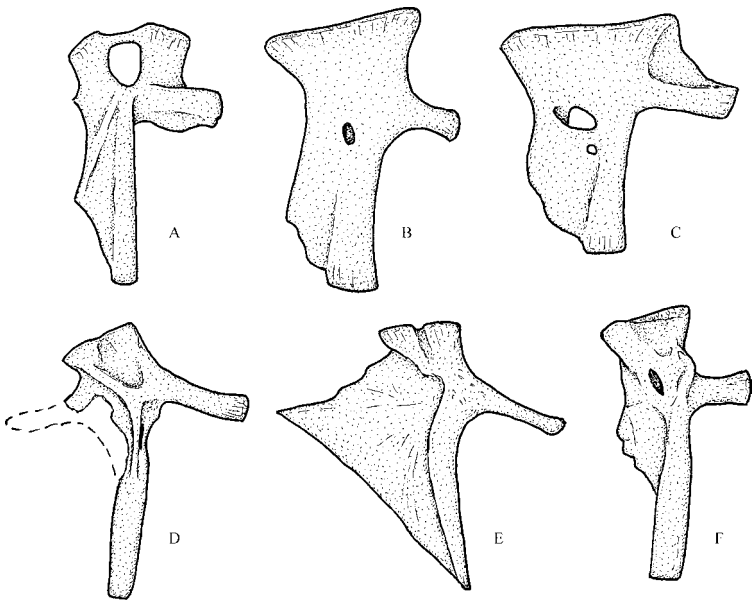

Figure 4: Hyomandibulae of (A) *Hiodon tergisus* LESUEUR, 1818 (modified from TAVERNE, 1977: fig. 15), (B) *Xenomystus nigri* GÜNTHER, 1868 (modified from TAVERNE, 1978: fig. 104), (C) *Papyrocranus afer* (GÜNTHER, 1868) (modified from TAVERNE, 1978: fig. 124, (D) *Phareodus acutus* LEIDY, 1873 (modified from TAVERNE, 1978: fig. 10), (E) *Phareodus queenslandicus* HILLS, 1934 (modified from HILLS, 1934: fig. 6) and (F) *Paralycoptera wui* CHANG & CHOU, 1977 (modified from XU & CHANG, 2009: fig. 7I) [not to scale].

An elongated opercular process on the hyomandibula is also present in a few other groups of Teleostei, for instance in some genera of the stephanoberyciform families Melamphaidae, Hispidoberycidae, Gibberichthyidae and Stephanoberycidae and of the beryciform family Trachichthyidae (KOTLYAR, 1996: pl. 15, 16, 28, 45, 48, 50, 52, 56, 58, 60, 62). However, all these families only contain marine fishes and were not present in the Early Cretaceous. Indeed, the Stephanoberycidae, the Hispidoberycidae and the Gibberichthyidae are recent fishes never mentioned in the fossil record. The Melamphaidae appear during the Eocene (NOLF, 1988) and the Trachichthyidae during the Upper Cenomanian (GAYET, 1980; among others).

The Hiodontidae or mooneyes appear in China during the Early Cretaceous, with genera such as *Plesiolycoptera* CHANG & CHOU, 1976 and *Yanbiania* LI, 1987 (SHEN, 1996; CHANG & MIAO, 2004). The family is still represented in the freshwaters of North America by *Hiodon* LESUEUR, 1818, a genus also known by a few fossil species (HILTON & GRANDE, 2008). *Hiodon* exhibits an elongated opercular process on the hyomandibula. This process is broadened in

its middle, the ventral branch of the bone is narrow and a very wide fenestra for the *truncus hyoideomandibularis* of the facial nerve (VII) is opened through the upper region of the bone (Fig. 4A; GREENWOOD, 1970: fig. 7B; TAVERNE, 1977: fig. 15; HILTON & GRANDE, 2008: figs 7, 9, 11, 13). The hyomandibula of *Hiodon* is thus different from that of sample MRAC RG 76.

The Notopteridae or knifefishes are a freshwater family that is today represented by four genera, two in Asia and two in Africa (ROBERTS, 1992). Their oldest mentioned occurrence dates back to the continental Albian-Lower Cenomanian, with *Palaeonotopterus* FOREY, 1997 from the Kem-kem beds in Morocco (FOREY, 1997). Two un-described archaic notopterid fishes also exist in the continental Barremian of Lebanon (TAVERNE, work in progress). *Palaeonotopterus*, the two Lebanese Lower Cretaceous notopterids and the two Asian genera, *Chitala* FOWLER, 1934 and *Notopterus* LACÉPÈDE, 1800, have a strong but short opercular process on the hyomandibula (TAVERNE, 1978: figs 69, 86, 2004: fig. 1A, B), while the two African genera, *Xenomystus* GÜNTHER, 1868 and *Papyrocranus* GREENWOOD, 1963, exhibit a long opercular process on the hyomandibula (Fig. 4B, C.; TAVERNE, 1978: figs 104, 124). But, once again, the general shape of the hyomandibula in these two last genera differs from that of specimen MRAC RG 76. In *Xenomystus* and *Papycranus*, the articular head has an elongate upper margin that is not divided in separated condyles and the anterior bony wing is attached all along the ventral branch of the hyomandibula. The opercular process in *Xenomystus* is shorter and forms a slightly acute angle with the ventral branch. In *Papyrocranus*, the long opercular process is linked to the upper region of the hyomandibula by a wide bony wing and the large foramen for the *truncus hyoideomandibularis* completely pierces the bone.

The Osteoglossidae are known in the fossil record since the Aptian, with genera such as *Chanopsis* CASIER, 1961 in Africa and *Xixiaichthys* ZHANG, 2004 and *Paralycoptera* CHANG & CHOU, 1977 in China (TAVERNE, 1984, 2016; ZHANG, 2004; XU & CHANG, 2009). The family still exists today, with the genera *Osteoglossum* CUVIER, 1829 in South America and *Scleropages* GÜNTHER, 1864 in Australia and eastern Asia. Fossil species of *Scleropages* are also present in the Paleocene of Europe and of Africa (TAVERNE *et al.*, 2007; TAVERNE, 2009b). Some authors add two other genera to the lineage, the African *Heterotis* CUVIER & VALENCIENNES, 1846 and the South American *Arapaima* MÜLLER, 1843, while others range them in a peculiar family, the Arapaimidae or Heterotidae. Two fossil osteoglossid genera possess a hyomandibula with an elongated opercular process and a feebly marked division of the articular region in two condyles, the North American and Australian *Phareodus* LEIDY, 1873 and the Chinese *Paralycoptera* (Fig. 4D, E, F; HILLS, 1934: fig. 6; TAVERNE, 1978: fig. 10; XU & CHANG, 2009: fig. 7H, I). In *Phareodus*, the opercular process is proportionally still longer than in sample MRAC RG 76. The posterior margin of the dorsal region of the hyomandibula and the opercular process determine a very obtuse angle. In *Paralycoptera*, the opercular process has the same length as in sample MRAC RG 76. The process and the upper part of the posterior margin of the bone form a straight angle, close to the morphology observed in the African specimen. The hyomandibula MRAC RG 76 seems thus to belong to an osteoglossid species more closely related to *Paralycoptera* than to *Phareodus*.

Without other known skeletal elements of this African fossil fish, I prefer to let it as an Osteoglossidae *incertae sedis* rather than to give it a formal scientific name or to range it officially in the genus *Paralycoptera*.

Sample MRAC RG 76 represents a second osteoglossid fish present in the continental Early Cretaceous of the Democratic Republic of Congo, the first one being *Chanopsis lombardi*. The two fishes can not be confounded as the hyomandibula of *Chanopsis lombardi* exhibits a short opercular process (CASIER, 1961: pl. 11, figs 3, 4; TAVERNE, 2016: fig. 6, A, B).

It is to be noted also that other osteoglossiform fishes are present in the fossil record of Central Africa but in marine deposits, *Paradercetis kipalaensis* CASIER, 1961and *Kipalaichthys sekirskyi* CASIER, 1961 from the Cenomanian of Kipala, in the Democratic Republic of Congo (TAVERNE, 1976) and *Ridewoodichthys caheni* (TAVERNE, 1969) from the Paleocene of the Cabinda Territory (TAVERNE, 1969, 2009a).

ACKNOWLEDGMENTS

I greatly thank Dr. Thierry De Putter and Dr. Florias Mees, from the Department of Geology of the Royal Museum for Central Africa (Tervuren), for allowing me the access to the materiel studied in the present paper, and Mt. Thierry Hubin, from the same Museum, and Mr. Adriano Vandersypen, from the Belgian Royal Institute for Natural Sciences, for their technical help. I am also grateful to the anonymous colleagues who have accepted to review my manuscript.

REFERENCES

BONDE, N., 2008. Osteoglossomorphs of the marine Lower Eocene of Denmark – with remarks on other Eocene taxa and their importance for paleobiogeography. *In*: CAVIN, L., LONGBOTTOM, A & RICHTER, M. (eds), *Fishes and the Break-up of Pangaea*, Geological Society, London, Special Publications 295: 253-310.

CAHEN, L., FERRAND, J. J., HAARSMA, M. J. F., LEPERSONNE, J. & VERBEEK, Th., 1959. Description du sondage de Samba. *Annales du Musée Royal du Congo Belge*, série in-8°, *Sciences géologiques*, 29: 1-210.

CAHEN, L., FERRAND, J. J., HAARSMA, M. J. F., LEPERSONNE, J. & VERBEEK, Th., 1960. Description du sondage de Dekese. *Annales du Musée Royal du Congo Belge*, série in-8°, *Sciences géologiques*, 34: 1-115.

CASIER, E., 1961. Matériaux pour la faune ichthyologique éocrétacique du Congo. *Annales du Musée Royal de l'Afrique Centrale*, série in-8°, *Sciences géologiques*, 39: 1-96.

CASIER, E., 1969. Addenda aux connaissances sur la faune ichthyologique de la série de Bokungu (Congo). *Annales du Musée Royal de l'Afrique Centrale*, série in-8°, *Sciences géologiques*, 62: 1-20.

CHANG, M. & MIAO, D., 2004. An overview of Mesozoic fishes in Asia. *In*: ARRATIA, G. & TINTORI, A. (eds), *Mesozoic Fishes 3 – Systematics, Paleoenvironments and Biodiversity*, Verlag Dr. F. PFEIL, München: 535-563.

COLIN, J.-P., 1994: Mesozoic-Cenozoic lacustrine sediments of the Zaïre Interior Basin. *In*, Gierlowski-Kordeschand, E. & Keltz, K. (eds), *Global Geological Record of Lake Basins, I.* G. C. P. Project 324, Cambridge University Press, Cambridge, 1: 31-36.

FOREY, P. L., 1997. A Cretaceous notopterid (Pisces: Osteoglossomorpha) from Morocco. *South African Journal of Science*, 93: 564-569.

GAYET, M., 1980. Contribution à l'étude anatomique et systématique des poissons cénomaniens du Liban, anciennement placés dans les acanthoptérygiens. *Mémoires du Muséum National d'Histoire Naturelle*, nouvelle série, série C, *Sciences de la Terre*, 44: 1-149.

GREENWOOD, P. H., 1970. On the genus *Lycoptera* and its relationship with the family Hiodontidae (Pisces, Osteoglossomorpha). *Bulletin of the British Museum (Natural History)*, *Zoology*, 19 (8): 259-285.

HILLS, E. S., 1934. Tertiary fresh water fishes from southern Queensland. *Memoirs of the Queensland Museum*, 10(4): 157-174.

HILTON, E. J. & GRANDE, L., 2008. Fossil Mooneyes (Teleostei: Hiodontiformes, Hiodontidae) from the Eocene of western North America, with a reassessment of their taxonomy. *In*: CAVIN, L., LONGBOTTOM, A. & RICHTER, M. (eds), *Fishes and the break-up of Pangaea*, Geological Society, London, Special Publications, 295: 221-251.

KOTLYAR, A. N., 1996. Beryciform fishes of the world ocean. VNIRO Publishing, Moscow : 1-368 (in Russian).

LEPERSONNE, J., 1977. Structure géologique du bassin intérieur du Zaïre. *Académie Royale de Belgique*, *Bulletin de la Classe des Sciences*, 5^{e} série, 63 (12): 941-965.

NOLF, D. 1988. Les otolithes de téléostéens éocènes d'Aquitaine (sud-ouest de la France) et leur intérêt stratigraphique. *Mémoires de l'Académie Royale de Belgique*, *Classe des Sciences*, collection in 4°, 2^{e} série, 19(2): 1-147.

ROBERTS, T., 1992. Systematic revision of the Old World freshwater fish family Notopteridae. *Ichthyological Exploration of Freshwaters*, 2(4): 361-383.

SHEN, M., 1996. Fossil "osteoglossomorphs" from East Asia and theit implications for teleostean phylogeny. *In*: ARRATIA, G. & VIOHL, G. (eds), *Mesozoic Fishes – Systematics and Paleoecology*, Verlag Dr. F. PFEIL, München: 261-272.

TAVERNE, L., 1969. Sur un squelette caudal d'Ostéoglossomorphe (*Brychaetus* ?) dans le
Paléocène (Montien) de Landana (Enclave de Cabinda). - Etablissement d'une nouvelle
espèce pour les restes de *Brychaetus* de Landana: *Brychaetus caheni* sp. nov. *Revue de Zoologie et de Botanique Africaines*, 79: 125-131.

TAVERNE, L., 1975. A propos de trois téléostéens salmoniformes fossiles du Crétacé inférieur (Wealdien) du Zaïre, précédemment décrits dans les genres *Leptolepis* et *Clupavus* (Pisces, Teleostei). *Revue de Zoologie Africaine*, 89(3): 481-504.

TAVERNE, L., 1976. Les téléostéens fossiles du Crétacé moyen de Kipala (Kwango, Zaïre). *Annales du Musée Royal de l'Afrique Centrale,* série in-8°, *Sciences géologiques,* 79: I-XI + 1-50.
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°, 2e 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°, 2e série, 42(6): 1-213.
TAVERNE, L., 1984. A propos de *Chanopsis lombardi* du Crétacé inférieur du Zaïre (Teleostei, Osteoglossiformes). *Revue de Zoologie Africaine*, 98(3): 578-590.
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 phylogénie des téléostéens ostéoglossomorphes. *Studi e ricerche sui giacimenti terziari di Bolca*, 7, *Miscellanea Paleontologica*, Museo Civico di Storia Naturale, Verona: 67-158.
TAVERNE, L., 2004. On a complete hyomandibular of the Cretaceous Moroccan notopterid *Palaeonotopterus greenwoodi* (Teleostei, Osteoglossomorpha). *Stuttgarter Beiträge zur Naturkunde*, *Serie B (Geologie und Paläontologie)*, 348: 1-7.
TAVERNE, L. 2009a. *Ridewoodichthys*, a new genus for *Brychaetus caheni* from the marine Paleocene of Cabinda (Africa): re-description and comments on its relationships within the Osteoglossidae (Teleostei, Osteoglossomorpha). Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre, 79: 147-153.
TAVERNE, L. 2009b. On the presence of the osteoglossid genus *Scleropages* in the Paleocene of Niger, Africa (Teleostei, Osteoglossomorpha). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique*, *Sciences de la Terre*, 79: 161-167.
TAVERNE, L., 2016. *Chanopsis lombardi* (Teleostei, Osteoglossiformes) from the continental Lower Cretaceous of the Democratic Republic of Congo. Comments on the evolution of the caudal skeleton within osteoglossiform fishes. *Geologica Belgica*, in press.
TAVERNE, L., NOLF, D. & FOLIE, A., 2007. On the presence of the osteoglossid genus *Scleropages* (Teleostei, Osteoglossiformes) in the continental Paleocene of Hainin (Mons Basin, Belgium). *Belgian Journal of Zoology*, 137(1): 88-97.
WILSON, M. V. H. & MURRAY, A. M., 2008. Osteoglossomorpha: phylogeny, biogeography, and fossil record and the significance of key African and Chinese taxa. *In*: CAVIN, L., LONGBOTTOM, A. & RICHTER, M. (eds), *Fishes and the break-up of Pangaea*, Geological Society, London, Special Publications, 295: 185-219.
XU, G.-H. & CHANG, M.-M., 2009. Redescription of +*Paralycoptera wui* Chang & Chou, 1977 (Teleostei: Osteoglossoidei) from the Early Cretaceous of eastern China. *Zoological Journal of the Linnean Society*, 157: 83-106.
ZHANG, J.-Y., 2004. New fossil osteoglossomorph from Ningxia, China. *Journal of Vertebrate Paleontology*, 24(3): 515-524.