

An Anglerfish, *Lophius* (Osteichthyes, Euteleostei, Lophiidae), from the Leitha Limestone (Badenian, Middle Miocene) of the Vienna Basin, Austria (Central Paratethys)

by

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SCHULTZ, O., 2006. An Anglerfish, *Lophius* (Osteichthyes, Euteleostei, Lophiidae), from the Leitha Limestone (Badenian, Middle Miocene) of the Vienna Basin, Austria (Central Paratethys). — Beitr. Paläont., 30:427–435, Wien.

Summary

The fish fauna of the Middle Miocene of St. Margarethen, Austria, is enlarged by the occurrence of the anglerfish or goosefish *Lophius* sp. based on a find consisting of two jaw bones, the illicium and the second spine of the first dorsal-fin. Keys for the identification of families and genera of lophiiform fishes are provided.

Keywords: *Lophius*, Badenium, Middle Miocene, St. Margarethen, Paratethys

Zusammenfassung

Die Faunenliste der mittelmiozänen Fischfundstelle St. Margarethen, Österreich, wird auf Grund eines Fundes, bestehend aus zwei Kieferknochen, dem Illizium und einem weiteren Stachel der 1. Rückenflosse, um den See-teufel *Lophius* sp. erweitert. Bestimmungsschlüssel für die Familien und Gattungen der Lophiiformes auf Grund paläontologisch erfassbarer Merkmale wurden erstellt.

1. Introduction

Thanks to the diligence of the committed fossil collector Mr. GOTTFRIED MAHLER, the specimen shown to the author in 1986 and dealt with herein was not lost. It was embedded in a piece of Leitha limestone and showed only two small parts of bones with projecting teeth. The subsequent preparation not only exposed the premaxilla with eleven teeth and the palatine, also bearing teeth, but also two long slender dorsal spines together with their complete basal parts. The shape of the tooth-bearing premaxilla and palatine pointed to an anglerfish. The exposure of the two dorsal spines confirmed this interpretation. This was the first proof of the anglerfish group (Lophiiformes)

in the 150-year-long history of collecting fossils in the St. Margarethen quarry in Burgenland, Austria. It remains the only evidence of the presence of Lophiiformes for the Leithagebirge area and, indeed, for the entire Paratethys. This find has already been listed as *Lophius* sp. in reports on the Middle Miocene fauna of St. Margarethen (e.g. SCHULTZ, 2001).

2. Material

Abbreviations:

NHMWien: Naturhistorisches Museum in Wien, Ichthyologische Sammlung, Burgring 7, 1010 Wien, Österreich - Austria.
NHMWien, GPA: Naturhistorisches Museum in Wien, Geologisch-Paläontolog. Abteilung, Burgring 7, 1010 Wien.- Österreich - Austria.
USNM: United States National Museum, National Museum of Natural History, Washington, D.C. 20560, USA.

2.1. Fossil material

Left premaxilla, left palatine together with left lacrymal, first spine of first dorsal-fin (= illicium), second spine of first dorsal. – These bones all lay together in one stone and clearly originated from one and the same individual; this is also confirmed by their dimensions and the way they adjoin. – Leitha Limestone, laminated marl facies: Badenian, Middle Miocene: St. Margarethen im Burgenland, quarry “Kummer”, Austria (NHMWien GPA 2006z0208/0001).

2.2. Recent material for comparisons

Lophius piscatorius LINNAEUS, 1758: Iceland (NHMWien 93.872: complete mounted skeleton),
Lophius piscatorius LINNAEUS, 1758 (NHMWien 94.223: complete mounted skeleton),
Lophius piscatorius LINNAEUS, 1758: Trieste, Italy (NHMWien 92.231: dissected skeleton mounted on board),
Lophius piscatorius LINNAEUS, 1758: Trieste, Italy (NHMWien 92.479: dissected skeleton mounted on board),
Lophius piscatorius LINNAEUS, 1758: Euböa, Greece (NHMWien 94.181: isolated parts of skull),

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- Lophius piscatorius* LINNAEUS, 1758: unknown provenance (NHMWien without number: isolated parts of skull),
Lophius budegassa SPINOLA, 1807: unknown provenance (NHMWien 89.645: specimen in alcohol),
Lophius budegassa SPINOLA, 1807: (NHMWien 94.034: complete mounted skeleton, 290 mm SL),
Lophius budegassa SPINOLA, 1807 Agadir, Morocco (NHMWien 94.182: complete mounted skeleton, 480 mm SL (Fig. 1),
Lophius sp.: Rovinj, Croatia (premaxilla),
Lophius sp.: ? (Fish market Vienna: isolated bones of skull),
Lophiodes mutilus (ALCOCK, 1894): Philippines (USNM 192600, 235 mm SL), digital photographs made by Sandra Raredon, USNM Washington, were placed at disposal
Lophiodes mutilus (ALCOCK, 1894): Indian Ocean (USNM 21520, 136 mm SL)
Lophiodes kempfi (NORMAN, 1935): Gulf of Guinea (USNM 213720, 150 mm SL), sketches drawn by J.C. Tyler, USNM Washington, were available to me,
Lophiodes beroe CARUSO, 1981: Lesser Antilles, Caribbean (USNM 213633, 187 mm SL) (Pl. 1, Fig. 3), sketches drawn by J.C. Tyler, USNM Washington, were available to me,
Lophiomus setigerus (VAHL, 1797): Philippines (USNM 213685, 190 mm SL), sketches drawn by J.C. Tyler, USNM Washington, were available to me,
Lophiomus setigerus (VAHL, 1797): India (USNM 216983, cleared and stained, 130 mm SL) (Pl. 1, Fig. 4), sketches drawn by J.C. Tyler, USNM Washington, were available to me,
Sladenia shaeferi CARUSO & BULLIS, 1976: Aruba, Netherlands Antilles, Caribbean (USNM 214478, 143 mm SL), sketches drawn by J.C. Tyler, USNM Washington, were available to me,
Ogcocephalus vespertilio (LINNAEUS, 1758); St. Petersburg, Florida, USA (NHMWien 78916),
Antennarius tenebrosus POEY; Cuba (NHMWien 16966).

3. Description of the fossil

The premaxilla is slightly curved. In the anterior part of the bone, three isolated, relatively large and slightly curved teeth are present. In the posterior half of the bone, six embedded, relatively small, slightly curved teeth are developed (Pl. 1, Fig. 1a). The length of the bone is 53 mm.

Dorsal spines: Two very slender bones with forked basis are preserved. Their lengths are 50 and 53 mm, respectively (Pl. 1, Fig. 1c).

Palatine and lacrymal: Anteriorly, the palatine bears two very large, curved teeth, the posterior half bears only two relatively small teeth; the area between the anterior and the posterior teeth is incompletely preserved. The typical "two-horned" lacrymal is preserved in the anterior edge of the palatine (Pl. 1, Fig. 1b). The length from anterior tip of lacrymal to end of palatine measures 34 mm.

4. Systematic palaeontology

Class Osteichthyes

Order Lophiiformes

4.1. Key to families

Based on the above-described characters, the determi-

nation as a representative of the order Lophiiformes is evident; for a comparison with recent material, see Pl. 1, Fig. 2a-c.

The order Lophiiformes consists of five suborders and 18 families (ESCHMEYER, 1990:460-461). The fossil from St. Margarethen shows the following osteological and odontological differences (▼) or similarities (▲) with the different suborders/families:

Suborder Lophioidei

Familia **Lophiidae**

▲ "The premaxillaries have posteriorly a single series of fixed teeth," [...] "The palatines have each a few teeth in a single series, the anterior of which are enlarged" (REGAN, 1903:278). – "recurved teeth; [...] first and second [spine of dorsal-fin] close together near tip of snout" (CARUSO, 1986a:363). – For example the representatives of the genus *Lophius* are complete conform in respect of form and dentition of premaxilla and palatine; 1st and 2nd dorsal spine are quite similar and more or less of the same length (based on the Recent material; see the list above with the available Recent material and Pl. 1, Fig. 2a-c).

Suborder Antennarioidei

Familia **Antennariidae**

▼ Teeth minute or villiform; dorsal-fin spines short or, beside illicium, no other similar dorsal spine (PIETSCH, 1986b: 366; GREGORY, 1933:390-393, fig. 265, 266). – "bands of small teeth in jaws and palatines" (RADCLIFFE, 1912:203). – "teeth rows, palatine: 3 – several" (BOESEMAN, 1964:16). – "First dorsal-fin consists of a single slender spine on the snout, followed by 2 separate stout spines." (MASUDA et al., 1984:102).

Familia **Tetrabanchidae**

▼ "Teeth very small", "First dorsal spine very short and slender, the second as long as the mouth and fringed, the third again very small" (DE BEAUFORT & BRIGGS, 1962: 221, 222).

Familia **Lophichthyidae**

▼ "Spinous dorsal with three separate spines, the first a well developed slender illicium", "Two series of smaller teeth are found" [...] "in a single patch on each palatine" (BOESEMAN, 1964:12, 13 and 16).

Familia **Brachionichthyidae**

▼ Beside illicium no similar dorsal spine (LAST et al., 1983:249-253).

Suborder Chaunacioidei

Familia **Chaunacidae**

▼ Teeth small; „Illicium short and stubby“, 2nd and 3rd dorsal-fin spine reduced or, beside illicium, no other similar dorsal-fin spine (PIETSCH 1986a: 362, SMITH 1986: 369, CARUSO & PIETSCH 1986: 1369). – "teeth rows upper jaw: (5) 4 or villiform bands"; "palatine: 2 teeth rows" (BOESEMAN, 1964:16).

Suborder Ogcocephaloidei

Familia **Ogcocephalidae**

▼ "A single short D spine (the illicium)" (PIETSCH, 1986a:

362). – “teeth villiform” BRADBURY, 1986:370).

Suborder Ceratioidei

Familia **Caulophyrnidae**

▼ Beside illicium no similar dorsal-fin spine; “teeth of jaws replaced by hooked denticles on tip of snout and lower jaw” (BERTELSEN, 1986a:1373-1375).

Familia **Neoceratiidae**

▼ No long illicium (PAPPENHEIM, 1914:198-199).

Familia **Melanocetidae**

▼ Beside illicium no similar dorsal-fin spine (PIETSCH, 1986e: 375; BERTELSEN 1986b:1376-1377).

Familia **Himantolophidae**

▼ Beside illicium no similar dorsal-fin spine or “Second D spine minute” (PIETSCH, 1986a:363; PIETSCH, 1986f:376; BERTELSEN, 1986c:1376-1377).

Familia **Diceratiidae**

▼ 1st and 2nd dorsal-fin spine extremely different in length (PIETSCH, 1986g:376-377; BERTELSEN, 1986d:1381-1382).

Familia **Oneirodidae**

▼ „Second D spine minute“ (PIETSCH, 1986a:363), illicium and 2nd dorsal-fin spine quite differently developed (PIETSCH, 1986d:375; BERTELSEN, 1986e:1183-1399). – *Dermatias*: “no palatine teeth” (RADCLIFFE, 1912:206).

Familia **Thaumatichthidae**

▼ Beside illicium no similar dorsal-fin spine (BERTELSEN, 1986f:1400).

Familia **Centrophrynidae**

▼ Beside illicium no similar dorsal-fin spine (BERTELSEN, 1986g:1401).

Familia **Ceratiidae**

▼ Beside illicium no similar dorsal-fin spine (PIETSCH, 1986c:373-375; BERTELSEN, 1986h:1403-1405).

Familia **Gigantactinidae**

▼ Beside illicium no similar dorsal-fin spine (BERTELSEN, 1986i:1406-1407).

Familia **Linophrynidae**

▼ Beside illicium no similar dorsal-fin spine (DE BEAUFORT & BRIGGS, 1962:259; BERTELSEN, 1986j:1408-1407).

The distribution of the above-listed characters favours the placement of the fossil within the Lophiidae.

Family Lophiidae

4.2. Key to genera

Only four of thirteen lophiid genera are valid (according to ESCHMEYER, 1990:55-226 and 460 and ESCHMEYER, 2005): *Lophiodes* (syn.: *Chirolophius*, *Pyrenophorus*), *Lophius* (syn.: *Batrachus* KLEIN, *Conomus*, *Discolophius*, *Lophidius*, *Lophiopsis*), *Lophiomus* and *Sladenia*. In the literature, the following characters for differentiation are listed, but those corresponding to the preserved fossil elements from St. Margarethen are only exceptionally mentioned or used (REGAN, 1903:277-285, CARUSO, 1981a:525, CARUSO, 1983:12 and 15, CARUSO, 1985:872-875, CARUSO, 1986b:1362-1363):

Lophiodes GOODE & BEAN, 1896

“3rd cephalic D spine present; humeral, articular, quadrate

and subopercular spines present” and “articular with a spine before and 1 after jaw point; sphenotic with 1 spine” (CARUSO, 1986a:364) and

“A single row of teeth on palatines” (DE BEAUFORT & BRIGGS, 1962:194: for *Chirolophius papillosus* [*Lophiodes papillosus*],

“3 à 5 dents palatines”: for *Chirolophius* (*Pyrenophorus*) *crosnieri* nov. sp. in LE DANOIS, 1974:77, according to ESCHMEYER, 2005: *Lophiodes insidiator* (REGAN, 1921),

“3 ou 4 dents palatines”: for *Chirolophius* (*Pyrenophorus*) *kempi* NORMAN, 1935 in LE DANOIS, 1974:80, according to ESCHMEYER, 2005: *Lophiodes kempi* (NORMAN, 1935)

“a row of 4 to 5 similar teeth on each palatine bone” for *Lophiodes infrabrunneus* SMITH & RADCLIFFE, 1912 (according to RADCLIFFE, 1912:202),

“4 à 6 dents palatines”: for *Chirolophius* (*Pyrenophorus*) *caulinaris* (GARMAN, 1899) in LE DANOIS, 1974:86, according to ESCHMEYER, 2005: *Lophiodes caulinaris* (GARMAN, 1899),

“a row of 5 to 7 similar teeth” for *Lophiodes olivaceus* SMITH & RADCLIFFE, 1912 (according to RADCLIFFE, 1912:201),

“7 dents palatines”: for *Chirolophius* (*Pyrenophorus*) *phycoides* nov. spec. in LE DANOIS, 1974:82, according to ESCHMEYER, 2005: *Lophiodes insidiator* (REGAN, 1921),

“7 dents palatines”: for *Chirolophius* (*Lophiodes*) *mutilus* (ALCOCK, 1893) in LE DANOIS, 1974:91, according to ESCHMEYER, 2005: *Lophiodes mutilus* (ALCOCK, 1894),

“long, stout dorsal spines” for *Lophiodes naresi* (according to CARUSO, 1981a:530).

Lophiomus GILL, 1893

“3rd cephalic D spine present; humeral, articular, quadrate and subopercular spines present” and “Soft D rays 8; A rays 6;” [...] “quadrate with one spine; interopercle with 2 spines; frontal ridge, outer surface of maxilla and lower jaw bearing low, sharp spines; vertebrae 19” (CARUSO, 1986a:364).

Lophius LINNAEUS, 1758

“3rd cephalic D spine present; humeral, articular, quadrate and subopercular spines present”, “articular with a single spine before jaw joint; sphenotic with 2 or 3 spines; and “Soft D rays 9-12; A rays 8-10;” [...] “quadrate with 2 spines; interopercle with 1 spine; vertebrae 26-31” (CARUSO, 1986a:364).

Sladenia REGAN, 1908

“3rd cephalic D spine absent; humeral, articular, quadrate and subopercular spines absent” (CARUSO, 1986a:364) and “Two rows of similar teeth, unequal in size, near symphysis of upper jaw, a single series of 8 nondepressible teeth on sides of premaxillary. A single canine on each side of vomer and a row of four or five similar teeth on palatines” (DE BEAUFORT & BRIGGS, 1962:195).

It is demonstrated here that most characters published in the literature are impracticable for the fossil find from St. Margarethen and cannot yield results. Ultimately, only characters of the palatine allow a differentiation:

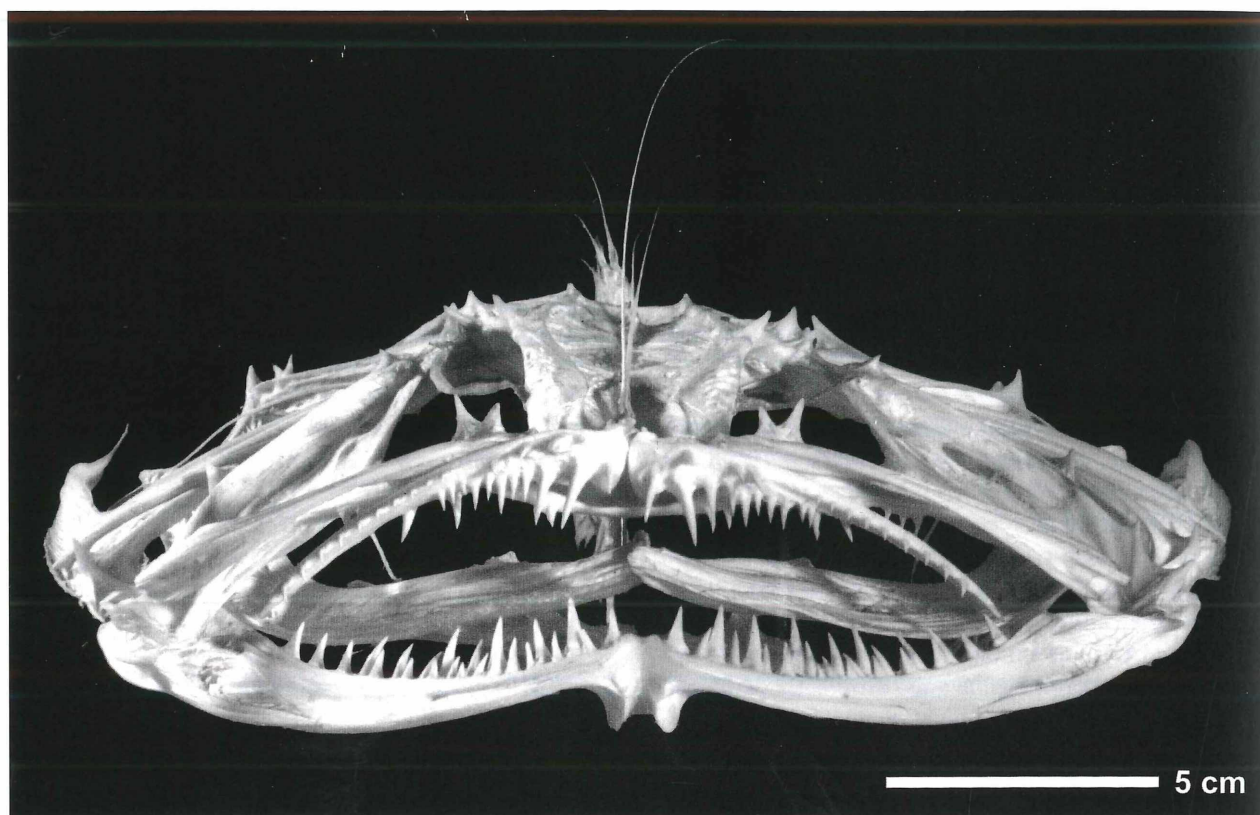


Figure 1: *Lophius budegassa* SPINOLA, 1807. Recent, Agadir, Morocco, front of skull. NHMWien 94.182:480 mm SL. Photo: A. Schuhmacher (NHMWien).

Lophiodes

In *L. beroe* (USNM 213633) the palatine bears seven teeth; the second is the largest, the fourth and the last one are only a little smaller than the largest; the first, the fifth and the sixth are approximately half the size of the second tooth; all the teeth are more or less straight and not curved (Pl. 1, Fig. 3);

In *L. kempi* (USNM 213720) the palatine possesses six teeth; the fourth is the largest and almost twice the size of the other teeth; also, the teeth in this species are more or less straight and are not (or only slightly) curved.

In *L. mutilus* (USNM 192600 und USNM 21520) the palatine bears five teeth; the third is the largest, the other ones are similar in size and approximately 75% the size of the largest tooth; all teeth relatively straight and are not (only slightly) curved.

Lophiomus

In *L. setigerus* (USNM 213685 and USNM 216983) the palatine bears six teeth of the same size, which are strongly curved (Pl. 1, Fig. 4).

Sladenia

In *S. shaefersi* (USNM 214478) the palatine bears five teeth; the third tooth is the largest, the other ones are of the same size.

Lophius

The palatine bears five to eleven teeth; the anterior two to five ones are twice the size of the posterior two to six ones; all teeth are strongly curved (Pl. 1, Fig. 2b).

The number of teeth of the palatine apparently has no generic value: e.g. the teeth numbers in the literature differ from these of the available specimens at the USNM (USNM 192600 and 21520). The curvature and the relative size of teeth seem to be of generic value:

In *Lophiodes* all the teeth are more or less straight, different in size, and only slightly curved (Pl. 1, Fig. 3), in *Lophiomus* all the teeth are of the same size and strongly curved (Pl. 1, Fig. 4),

in *Sladenia* the tooth in the middle is the largest, the two teeth before and also the two behind the largest are of the same size.

In *Lophius*, all the teeth are strongly curved and there is an anterior group of teeth with large and a posterior group of small teeth (Pl. 1, Fig. 2b).

According to these definitions the fossil find from the Middle Miocene of St. Margarethen cannot be determined as *Lophiodes*, *Lophiomus* or *Sladenia*, but there are very good conformities with *Lophius* LINNAEUS, 1758.

The fish (Pl. 1, Fig. 1) is therefore determined here as

Genus *Lophius* LINNAEUS, 1758

Lophius sp. (Plate 1, fig. 1)

Material: One specimen consisting of a left premaxilla, a left palatine together with left lacrymal, the first spine of first dorsal-fin (= illicium), and the second spine of first dorsal. – Leitha Limestone, laminated marl facies: Badenian, Middle Miocene: St. Margarethen im Burgenland, quarry

“Kummer”, Austria (NHMWien GPA 2006z0208/0001).

Description: see chapter 3

Discussion along with determination of the species: Besides other Recent species of *Lophius* (such as *L. americanus* VALENCIENNES, 1837, *L. litulon* JORDAN, 1902, *L. vomerinus* VALENCIENNES, 1837), *Lophius piscatorius* LINNAEUS, 1758 (+ synonyms such as *L. vaillanti* = *L. cailanti* REGAN, 1903) and *L. budegassa* SPINOLA, 1807 (Fig. 1) can be distinguished by the number of dorsal rays (9-10 in *budegassa* versus 11-12 in *L. piscatorius*), the length of the third cephalic dorsal spine (short in *L. budegassa*, long in *L. piscatorius*), and the number of vertebrae (25-27 in *L. budegassa*, 30-32 in *L. piscatorius*) (ARAMBOURG, 1927: 216; LE DANOIS, 1974:111, 118; CARUSO, 1986b:1362-163). These elements are not preserved in the St. Margarethen's fossil. Therefore, only the palatine dentition was examined in this case. The formula and description is for *L. piscatorius*: 2-5 large + 2-6 small teeth, all are strongly curved (based on six individuals) and, for *L. budegassa*: 1-3 large + 3-5 small teeth, all are strongly curved (based on three individuals).

The comparison reveals that the palatine dentition cannot be used to differentiate *L. piscatorius* and *L. budegassa*. A further result is that a specific differentiation based on the palatine and palatine dentition is not possible. The consequence for the find from the Middle Miocene of St. Margarethen (Pl. 1, Fig. 1) is that no specific determination is suitable and the determination is therefore left at generic level, *Lophius* sp.

Hitherto known Cenozoic Lophiidae resp. Lophius:

The following taxa list provides an overview of all the fossil evidence of the Lophiidae. All the here-listed taxa have no nomenclatural consequences for the Middle Miocene St. Margarethen find.

1) *Lophius brachysomus* AGASSIZ, 1835: Lower Eocene. – Monte Bolca, Italy. – VOLTA, 1796:95-97, pl. 20, fig. 4 (*Loricaria plecostomus*), 175-177, pl. 42, fig. 3 (*Lophius piscatorius*). – AGASSIZ, 1835:292 (*Lophius brachysomus* instead of *Loricaria plecostomus*), 294 (*Lophius brachysomus* instead of *Lophius piscatorius*). – AGASSIZ, 1839: pl. 40, fig. 1-4. – AGASSIZ, 1844:114. – WOODWARD, 1901:591. – BLOT, 1980:353-354 (“elle conduira à la création d'un nouveau genre”).

2) *Lophius sagittidens* WINKLER, 1874: Eocene: numerous localities in Belgium. – WINKLER, 1874:16ff and 1876:31-43, pl. 2, fig. 22+23 (*Trichiurides sagittidens* WINKLER). – DAMES, 1883:669-670, footnote 4 [arranged to *Lepidosteus* !]. – WOODWARD, 1895:445 [arranged to *Lepidosteidae* !]. – LERICHE, 1905:81 + 172-173 + 197 (isolated teeth). – LERICHE, 1906:170-173, 268, 270, 272, 323, 332. – The teeth figured in WINKLER, 1874: pl. 2, fig. 22+23 cannot be determined as *Lophius* or as a Lophiidae but also not as *Lepidosteus* or as a *Lepidosteidae*. The investigations by CASIER, 1944:2-5 and 1966:326 and 244ff reveal that the tooth (fig. 22 in WINKLER, 1874) must be retained as *Trichiurides sagittidens* and must be arranged in the family Merlucciidae. For the second tooth (fig. 23 in WINKLER, 1874), CASIER erected a new genus and new species: *Eutrichiurides winkleri* CASIER (1946).

3) *Lophius piscatorius* LINNAEUS, 1758: Pliocene: Orciano, Tuscany, Italy. – LAWLEY, 1876:77, pl. 5, fig. 2-c (teeth on fragments of bones: *Lophius brachyostomus*. AGAS.); DE STEFANO, 1909:557, 627-628, pl. 18, fig. 29-32 (tooth or teeth on fragments of bones); LANDINI, 1977:126, pl. 5, fig. 7 (teeth on fragments of bones).

4) *Lophius orpiensis* LERICHE, 1906: Landenian, Paleocene: Orpe-le-Grand, Belgium. – LERICHE, 1906:120, 121.

5) *Lophius dolloi* LERICHE, 1908: Upper Rupelian, Oligocene: Bassel (Steendorp), Boom, Niel, Rumst, Rupelmonde, Tehaegen, Belgium. – LERICHE, 1910:347-348, pl. 26 (premaxilla, palatine, dentary, vertebrae).

6) *Emmachaere rhachites* JORDAN & GILBERT, 1919 (Lophiidae ?): Miocene. – Lompoc, Southern California, USA. – JORDAN & GILBERT, 1919:59, pl. 28, fig. 2 (print fragment).

7) *Lophius cf. piscatorius* LINNAEUS, 1758 [1735]: Neogene: Wommelghem, Belgium. – LERICHE, 1926:455, pl. 41, fig. 6 (premaxilla).

8) *Lophius* sp. – Neogene: Anvers, Belgium. – LERICHE, 1926:456, pl. 41, fig. 7 (premaxilla).

9) *Lophius budegassa* SPINOLA, 1807: Messinian, Upper Miocene: Sig (2 finds), Raz-el-Ain (1 find) and Planteurs (1 find), Algeria. – ARAMBOURG, 1927:214-217, pl. 40, fig. 4, pl. 41, fig. 1 [print with skull bones.- e.g. ARAMBOURG compares with *Lophiomus*].

10) *Lophius* sp.: Pleistocene: Virginia, USA. – RAY et al., 1968:11 (dentary and scapulocoracoid).

11) Lophiidae. Nov. gen.-nov. sp.: Lower Eocene: Monte Bolca, Italy. – BLOT, 1980:354.

5. Ecological information

Representatives of the genus *Lophius* are known from all tropical and temperate oceans: e.g. *Lophius piscatorius* is distributed in area of the Gulf Stream from southern Iceland and northern Norway to Morocco in the northeastern Atlantic and in the Mediterranean; *Lophius budegassa* (Fig. 1) is known from the Mediterranean and in Eastern Atlantic as far as Senegal, *Lophius upsicephalus* from the South Atlantic to the southwestern Indian Ocean, *Lophius litulon* in the Western North Pacific. The habitat of *Lophius* is sandy to muddy bottoms of coastal waters to the deep sea down to 1000 meters. Thus, no precise information about the environment of the Middle Miocene locality St. Margarethen can be provided by this fossil, except the confirmation of the marine origin of the deposit.

6. Acknowledgements

First of all I express my cordial thanks to the finder and distributor of the here-documented find, to Mr. Gottfried Mahler. Then I thank Mr. Walter Prenner (NMWien) for his careful and successful preparation of the find. Special information about the Recent species of *Lophius* was given to me by Mr. John Caruso, New Orleans. I am very indebted to Mr. James C. Tyler (Smithsonian Institution United States National

Museum, National Museum of Natural History, Washington, D.C.) for his kind support in making available the dentition of five species with seven specimens (listed in the chapter Recent material) which were not available to me in Vienna. Mrs. Sandra J. Raredon (Smithsonian Institution, Division of Fishes) kindly made the digital photographs; also to her my thanks. Finally, I am grateful to Mrs. Alice Schumacher for the photographic work here in Vienna and to the staff in the ichthyological collection, Mrs. Christa Prenner, Mr. H. Wellendorf, M. Reithofer and Ch. Pollmann (all NHMWien).

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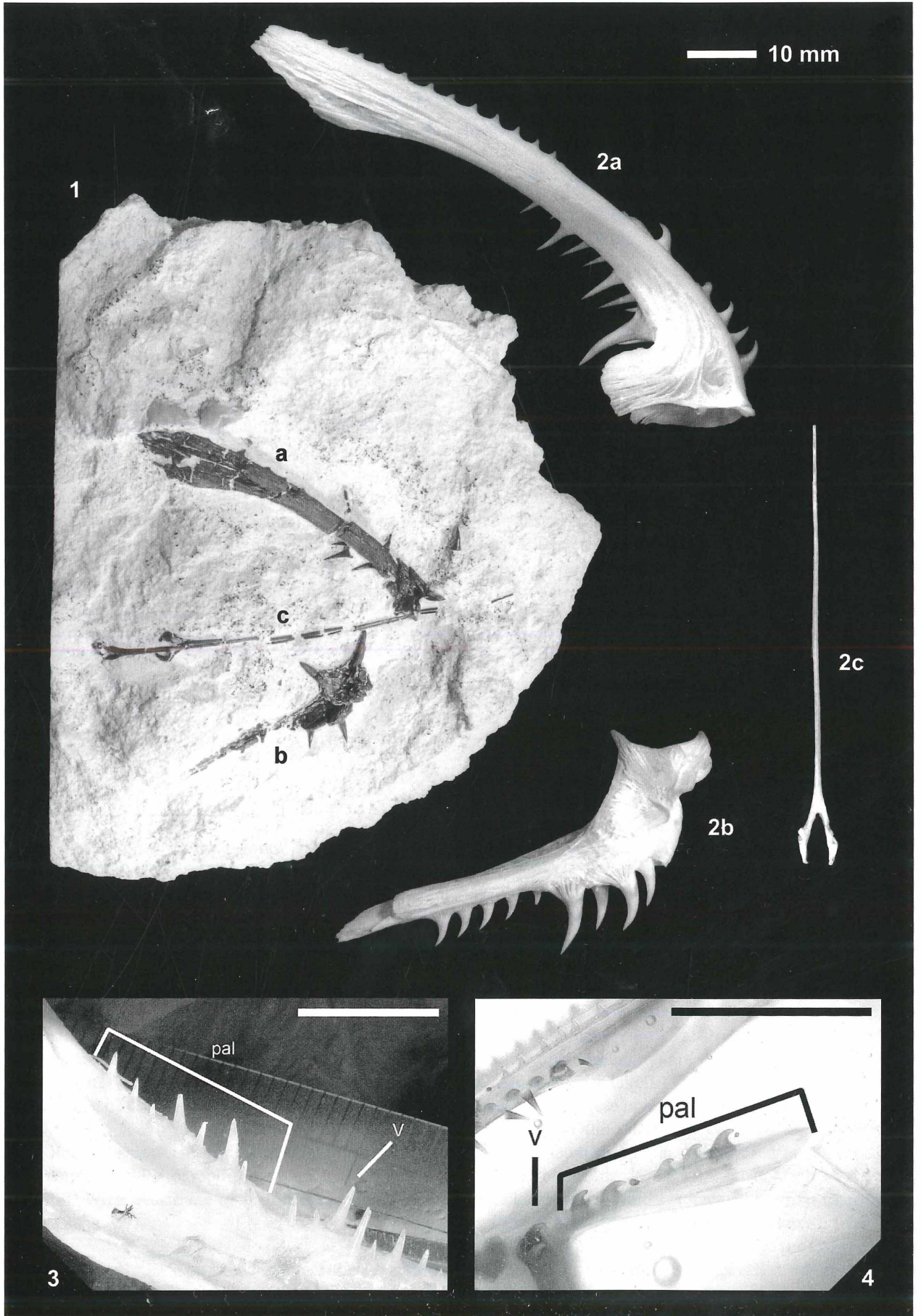
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PLATE 1

- Fig. 1 *Lophius* sp. — Laminated facies of Leitha Limestone, Badenium, Middle-Miocene. — St. Margarethen im Burgenland, Austria. — a: left premaxilla and some isolated teeth; b: lacrymal and palatine with two large and two small teeth; c: illicium and the second spine of the first dorsal-fin, both with forked basis. — NHMWien GPA 2006z0208/0001. — Scale bar in the right upper corner: 10 mm.
- Fig. 2 *Lophius* sp. — Recent. — fish market, Vienna. — a: left premaxilla; b: left lacrymal and palatine; c: illicium. — Scale bar in the right upper corner: 10 mm.
- Fig. 3 *Lophiodes beroe* CARUSO, 1981. — Recent. — Lesser Antilles, Caribbean. — Teeth of palatine. — USNM 213633. — Scale bar: 10 mm.
- Fig. 4 *Lophiomus setigerus* (VAHL, 1797). — Recent. — India. — Teeth of palatine. — USNM 216983. — Scale bar: 10 mm.

Photos: Fig. 1 and 2: A. Schumacher (NHMWien). Fig. 3 and 4: S. J. Raredon & J.C. Tyler (Smithsonian Institution, Division of Fishes, Washington D.C.).

PLATE 1



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Autor(en)/Author(s): Schultz Ortwin

Artikel/Article: [An Anglerfish, Lophius \(Osteichthyes, Euteleostei, Lophiidae\), from the Leitha Limestone \(Badenian, Middle Miocene\) of the Vienna Basin, Austria \(Central Paratethys\) 427-435](#)