

# *Callionymus profundus* n. sp., a new species of dragonet from the Gulf of Aqaba (Gulf of Eilat), Red Sea (Teleostei: Callionymidae)

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## Abstract

A new species of deep-living dragonet, *Callionymus profundus*, from the northern Red Sea, is described on the basis of a single male specimen. The new species is compared with similar species. Revised keys to callionymid fish species of the western Indian Ocean and the Red Sea, as well as species of the subgenus *Callionymus* (*Bathycallionymus*), are presented. Another species of the subgenus, *Callionymus carebares* Alcock, 1890, is recorded for the first time from the Andaman Sea, Thailand.

**Key words:** Fishes, dragonets, Callionymidae, new species, new record, Red Sea, Andaman Sea, Israel, Thailand, identification key.

## Zusammenfassung

Eine neue Art in tiefem Wasser lebender Leierfische, *Callionymus profundus*, wird aus dem nördlichen Roten Meer beschrieben. Die neue Art wird mit ähnlichen Arten verglichen. Diese Arbeit enthält revidierte Bestimmungsschlüssel der Callionymidae des westlichen Indischen Ozeans und Roten Meeres, sowie der Arten der Untergattung *Callionymus* (*Bathycallionymus*). Eine weitere Art der Untergattung, *Callionymus carebares* Alcock, 1890, wird erstmals aus der Andamanensee (Thailand) nachgewiesen.

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## 1 Introduction

Dragonets of the family Callionymidae are a group of benthic living fishes occurring in the upper 900 metres of all temperate, subtropical and tropical oceans of the world, and a few species are found in estuarine and freshwater habitats. The Indo-Pacific species were revised by FRICKE (1983a), who distinguished 126 valid species from the area, including three species from the Mascarenes. FRICKE (2002), in a checklist of the callionymid fishes of the world, listed a total of 182 valid species in 10 genera. Subsequently, five additional species (*Callionymus kanakorum* and *Protogrammus antipodum* from New Caledonia, *Tonlesapia tsukawakii* and *T. amnica* from Cambodia and Vietnam, respectively, and *Synchiropus tudorjonesi* from Papua, Indonesia) were described by FRICKE (2006), MOTOMURA & MUKAI (2006), NG & RAINBOTH (2011), and ALLEN & ERDMANN (2012), respectively, and *Eleutherochir mccaddeni* Fowler, 1941 was removed from the synonymy of *E. opercularis* by YOSHIGOU et al. (2006), bringing the worldwide total to 188 species in the family.

FRICKE (1981: 350) defined the *kaianus* species-group of the genus *Callionymus* as having a combination of large eyes, 4 flexible spines in the first dorsal fin, 9 rays each in the second dorsal and anal fins, one or two median unbranched caudal-fin rays which are often filamentous, a characteristic shape of the preopercular spine with a small antrorse barb in addition to 1–3 larger curved points on the dorsal margin, and (usually) a characteristic black blotch on the third membrane of the first dorsal fin. He distinguished 13 species in the group, most of which are endemic in small distribution ranges within the Indo-West Pacific. NAKABO (1982: 86) described the genus *Bathycallionymus* with *Callionymus kaianus* Günther, 1880 as the type species. FRICKE (2002: 99) treated *Bathycallionymus* (the former *kaianus* species-group) as a subgenus of the genus *Callionymus*, and distinguished 18 species. FRICKE (2006) described *Callionymus kanakorum*, another member of the subgenus, from New Caledonia. FRICKE et al. (2011) recorded *Callionymus kanakorum* from Espiritu Santo, Vanuatu.

A single specimen of an undescribed species of the subgenus, which was previously misidentified as *Callionymus*

*bentuviai*, was trawled in deep water of the northern Gulf of Aqaba (Gulf of Eilat), Israel, Red Sea. This obviously very rare species is described herein, and brings the total number of species known in the subgenus to 19.

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## 2 Methods and Materials

Methods follow FRICKE (1983a); fin-ray counts follow FRICKE (1983b). The starting point for length measurements is the mid of the upper lip. The standard length (measured from the tip of the upper lip to the middle of the urohyal/caudal-fin base) is abbreviated SL, the lateral line is abbreviated LL, the dorsal fin D, the anal fin A. The predorsal (1) length is measured from the mid of the upper lip to the base of the first spine of the first dorsal fin; the predorsal (2) length correspondingly to the base of the first ray of the second dorsal fin. The last ray of the second dorsal and anal fins is always divided at its base; counts in the key include this divided ray as one. For the pectoral fins, 2 values for the fin-ray number are provided, as the numbers of the left and the right fin are counted. Species are classified based on FRICKE (2002). Nomenclature follows ESCHMEYER (2012). References and journals follow FRICKE (2012) and FRICKE & ESCHMEYER (2012a); abbreviations of museum collections (see below) follow FRICKE & ESCHMEYER (2012b).

#### Abbreviations of museum collections

AMS	The Australian Museum, Sydney, Australia
BMNH	The Natural History Museum, London, UK [formerly British Museum (Natural History)]
CAS	California Academy of Science, San Francisco, USA
CSIRO	CSIRO Marine & Atmospheric Research, Hobart, Australia
FAKU	The Kyoto University Museum, Kyoto, Japan [formerly Department of Fisheries, Faculty of Agriculture, Kyoto University, Kyoto, Japan]
FMNH	Field Museum of Natural history, Chicago, USA
HUJ	Hebrew University, Fish Collection, Jerusalem, Israel
HUMZ	The Hokkaido University Museum, Sapporo, Japan [formerly Museum of Zoology, Hokkaido University, Hakodate, Japan]
IRSN	Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium
MNHN	Muséum National d'Histoire Naturelle, Paris, France
MSL	Marine Science Laboratory, Chinese University of Hong Kong, China

NSMT	National Museum of Nature and Science, Tsukuba, Tokyo, Japan [formerly National Science Museum]
NTM	Northern Territory Museum of Arts and Science, Darwin, Australia
QM	Queensland Museum, Brisbane, Australia
RMNH	Naturalis, Nederlands Centrum voor Biodiversiteit, Leiden, Netherlands [formerly Rijksmuseum van Natuurlijke Historie]
SMNS	Staatliches Museum für Naturkunde Stuttgart, Germany
USNM	National Museum of Natural History, Smithsonian Institution, Museum Support Center, Suitland, MD, USA
WAM	Western Australian Museum, Perth, Australia
ZIM	Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany
ZMUC	Zoologisk Museum, University of Copenhagen, Denmark
ZSI	Zoological Survey of India, Kolkata, India

#### Comparative material

*Callionymus africanus* (Kotthaus, 1977): ZIM 5533 (holotype), seamount NE of Mombasa, Kenya; BMNH 1939.5.24.1422 (1), near Zanzibar, Tanzania; RMNH 19984 (6), seamount on Chain Ridge, off Somalia; ZIM 5534 (30 paratypes), seamount NE of Mombasa, Kenya.

*Callionymus altipinnis* Fricke, 1981 (all China): MSL 0001 (holotype), Hong Kong; CAS 46967 (10 paratypes), Hainan; CAS 46968 (1 paratype), Hainan; CAS 46969 (1 paratype), Hainan.

*Callionymus bentuviai* Fricke, 1981 (all Eritrea, southern Red Sea): HUJ 9935 (holotype); HUJ 6674 (2); HUJ 6675 (1); HUJ 8068 (2 paratypes); HUJ 10463 (2); ZIM 5532 (2 paratypes).

*Callionymus bifilum* Fricke, 2000: CSIRO CA.3532 (holotype), Joseph Bonaparte Gulf, Western Australia; BMNH 1892.1.14.26–27 (2 paratypes), Holothuria Bank, Western Australia.

*Callionymus bleekeri* Fricke, 1983: RMNH 4872 (holotype), Java, Indonesia.

*Callionymus carebares* Alcock, 1890: BMNH 1890.11.28.18–24 (7 syntypes), Ganjam, India; MNHN 1890-0335–0340 (6 syntypes), Ganjam, India; ZSI F.12740–F.12741 (2 syntypes), Ganjam, India; ZSI F.12742 and F.12858 (15 syntypes), Ganjam, India; AMS I.28730-001 (1), Maputo, Mozambique; BMNH 1903.5.14.34 (1), Karachi, Pakistan; BMNH 1904.5.25.218–220 (3), Sea of Oman, Oman; BMNH 1939.5.24.1384 (1), Gulf of Oman, Oman; BMNH 1939.5.24.1385–1409 (24), Arabian Sea; BMNH 1939.5.24.1410–1421 (15), Gulf of Aden, Yemen; FMNH 5740 (1), Sea of Oman, Oman; IRSN 1797 (2), Bay of Bengal, India; SMNS 23508 (1), Thailand, Andaman Sea (**new record**).

*Callionymus formosanus* Fricke, 1981: CAS 46972 (holotype), Pescadores Strait, Taiwan.

*Callionymus futuna* Fricke, 1998 (all Wallis and Futuna, Futuna Island shelf): MNHN 1995-0521 (holotype); MNHN 1995-0522 (2 paratypes); SMNS 18823 (1 paratype).

- Callionymus guentheri* Fricke, 1981 (all Philippines): BMNH 1879.5.14.567 (holotype), Zamboanga; CAS 32668 (2 paratypes), Batangas, Luzon; CAS 32801 (1 paratype), Marinduque; CAS 32897 (11 paratypes), Batangas, Luzon; CAS 32905 (7 paratypes), Camarines Sur; CAS 32916 (5 paratypes), Quezon, Luzon; CAS 32997 (1 paratype), Balayan Bay; CAS 33067 (1 paratype), Luzon; CAS 33703 (1 paratype), Balayan Bay; CAS 33864 (3 paratypes), Camarines Sur; CAS 33879 (1 paratype), Marinduque; CAS 34074 (1 paratype), Marinduque; CAS 34154 (7 paratypes), Marinduque; CAS 34190 (2 paratypes), Ragay Gulf; CAS 34197 (9 paratypes), Camarines Sur; CAS 34205 (1 paratype), Marinduque; CAS 34272 (1 paratype), Ragay Gulf; CAS 34278 (4 paratypes), Marinduque; CAS 34286 (3 paratypes), Marinduque; CAS 34401 (1 paratype), Balayan Bay; CAS 34426 (1 paratype), Batangas, Luzon; CAS 34468 (1 paratype), Balayan Bay; CAS 46966 (4 paratypes), Quezon; SMNS 8510 (2), Occidental Mindoro; SMNS 9097 (1), Occidental Mindoro; USNM 150916 (1), Cabuyan Grande Island.
- Callionymus kaianus* Günther, 1880 (all Kai Islands, Maluku, Indonesia): BMNH 1879.5.14.565 (holotype); ZMUC P.6498 (1); ZMUC P.6499 (1).
- Callionymus kailolae* Fricke, 2000: AMS I.22807-021 (holotype), north of Port Hedland, Western Australia.
- Callionymus kanakorom* Fricke, 2006: MNHN 2000-5519 (holotype), Grande Terre, New Caledonia; SMNS 8550 (1 paratype), Grande Terre, New Caledonia; SMNS 12047 (1 paratype), Grande Terre, New Caledonia.
- Callionymus kotthausi* Fricke, 1981: ZIM 5535 (holotype), Cochin, India; ZIM 5536 (11 paratypes), Cochin, India.
- Callionymus moretonensis* Johnson, 1971 (all Australia): AMS I.15608-001 (holotype), Cape Moreton, Queensland; CAS 24764–24767 (4 paratypes), Cape Moreton, Queensland; QM I.9156–I.9157 (2 paratypes), Cape Moreton, Queensland; SMNS 12172 (5), Arafura Sea, Northern Territory; SMNS 12173 (8), Arafura Sea, Northern Territory; SMNS 14791 (13), off Newcastle, New South Wales; WAM P.25739-003 (1), Cape Moreton, Queensland.
- Callionymus ochiaii* Fricke, 1981: FAKU 23261 (holotype), Kagoshima Prefecture, Japan; FAKU 23257–23260 and 23275 (5 paratypes), Kagoshima Prefecture, Japan; USNM 160485 (1), Goto Island, Japan.
- Callionymus regani* Nakabo, 1979 (all Saya de Malha Bank, western Indian Ocean): HUMZ 72408 (holotype); BMNH 1908.3.23.263 (1); HUMZ 72325 (1 paratype); HUMZ 72359 (1 paratype); HUMZ 42405 and 42407 (2 paratypes); HUMZ 73395 (1 paratype); HUMZ 73448–73449 (2 paratypes); HUMZ 73681 (1 paratype).
- Callionymus semeiophor* Fricke, 1983: NTM S.10764-001 (holotype), Sumbawa, Indonesia; NTM S.10760-002 (1 paratype), Lombok, Indonesia.
- Callionymus sokonumeri* Kamohara, 1936: NSMT P.21026–21027 (2), Mimase, Japan; NSMT 23873 (1), Kagoshima, Japan.
- Callionymus whiteheadi* Fricke, 1981: BMNH 1980.6.20.1 (holotype), Bali, Indonesia; BMNH 1980.11.25.2 (1 paratype), Java, Indonesia.

### 3 Taxonomy

#### *Callionymus (Bathycallionymus) profundus* n. sp. (Figs. 1, 2A)

*Callionymus bentuviai* (misidentified, non Fricke, 1981): BARANES & GOLANI 1993: 309, pl. 14, fig. 47 (Gulf of Aqaba, Red Sea, 410–480 m depth).

**Holotype:** HJ 16989, male, 65.1 mm SL, Israel, Eilat, Gulf of Aqaba (Gulf of Eilat), Red Sea, coll. A. BARANES, 11 Feb. 1992.

#### Diagnosis

A *Callionymus* of the subgenus *Bathycallionymus* with a small branchial opening; head short (3.9 in SL); eye large (2.04 in head length); preopercular spine with a small antrorse barb and a larger antrorse spine, and a strong antrorse spine at its base, ventral margin smooth; first dorsal fin slightly higher than second dorsal fin (male); second dorsal fin distally straight; caudal fin distally slightly pointed, with 2 median unbranched rays bearing short filaments; first dorsal fin with basal black spot reaching from second to third membranes, third membrane with a distal black margin; second dorsal fin with vertical dark grey bars; anal fin distally black, tip of fin rays also black.

#### Description

D IV + viii, 1; A viii, 1; P<sub>1</sub> ii, 15–16, i–ii (total 18–20); P<sub>2</sub> I, 5; C (ii), i, 3, ii, 2, (iii). Proportions are given in Tab. 1.

Body elongate and depressed. Head depressed. Eye large. Interorbital very narrow. Preopercular spines broken, only left spine partially preserved; shape of main tip unknown, ventral margin smooth, base with a strong antrorse spine, and 1 small antrorse barb and 1 large, curved point on dorsal margin, formula  $1\frac{2}{-}1$ . Cephalic lateral-line system with a preorbital branch, a short suborbital branch with a downward extension, a disconnected preopercular branch, a short, separate mandibular branch, and a supraoccipital commissure connecting lines of opposite sides. Occipital region smooth, without bony protuberances. Body lateral-line system without dorsal branches, but with one commissure dorsally on the caudal peduncle connecting the lateral lines of the opposite sides; lateral line reaching along about half the length of the upper median unbranched caudal-fin ray. Urogenital papilla short.

First dorsal fin slightly higher than second dorsal fin, without filaments, and the membranes moderately incised. Second dorsal fin distally straight, rays unbranched, the last divided at its base, posterior branch of last ray slightly elongate. Anal fin beginning on vertical through 2<sup>nd</sup> membrane of second dorsal fin. Anal fin distally straight; anal-fin rays unbranched, the last divided at its base. Pectoral fin reaching to base of 2<sup>nd</sup> anal-fin ray when adpressed.



**Tab. 1.** Proportions of the holotype of *Callionymus profundus* n. sp., catalogue number HUI 16989.

Head length in SL	3.9
Body depth in SL	7.3
Body width in SL	6.1
Caudal peduncle length in SL	5.2
Caudal peduncle depth in SL	24.0
Eye diameter in head length	2.04
Preorbital length in head length	3.9
Interorbital distance in head length	22.3
Upper jaw length in head length	3.0
Urogenita papilla length in head length	17.0
Predorsal (1) length in SL	3.2
Predorsal (2) length in SL	2.2
Preanal length in SL	2.0
Prepectoral length in SL	2.7
Prepelvic length in SL	3.9
Length of 1 <sup>st</sup> spine of first dorsal fin in SL	5.5
Length of 2 <sup>nd</sup> spine of first dorsal fin in SL	5.8
Length of 3 <sup>rd</sup> spine of first dorsal fin in SL	5.7
Length of 4 <sup>th</sup> spine of first dorsal fin in SL	8.8
Length of 1 <sup>st</sup> ray of second dorsal fin in SL	6.0
Length of 5 <sup>th</sup> ray of second dorsal fin in SL	5.5
Length of last ray of second dorsal fin in SL	6.0
Length of 1 <sup>st</sup> ray of anal fin in SL	11.8
Length of 5 <sup>th</sup> ray of anal fin in SL	8.2
Length of last ray of anal fin in SL	6.2
Pectoral-fin length in SL	5.0
Pelvic-fin spine length in SL	12.8
Pelvic-fin length in SL	3.5
Caudal-fin length in SL	2.6

Pelvic fin reaching to base of 1<sup>st</sup> anal fin membrane when adpressed. Membrane connecting 5<sup>th</sup> pelvic-fin ray with pectoral-fin base ending opposite 10<sup>th</sup> pectoral-fin ray

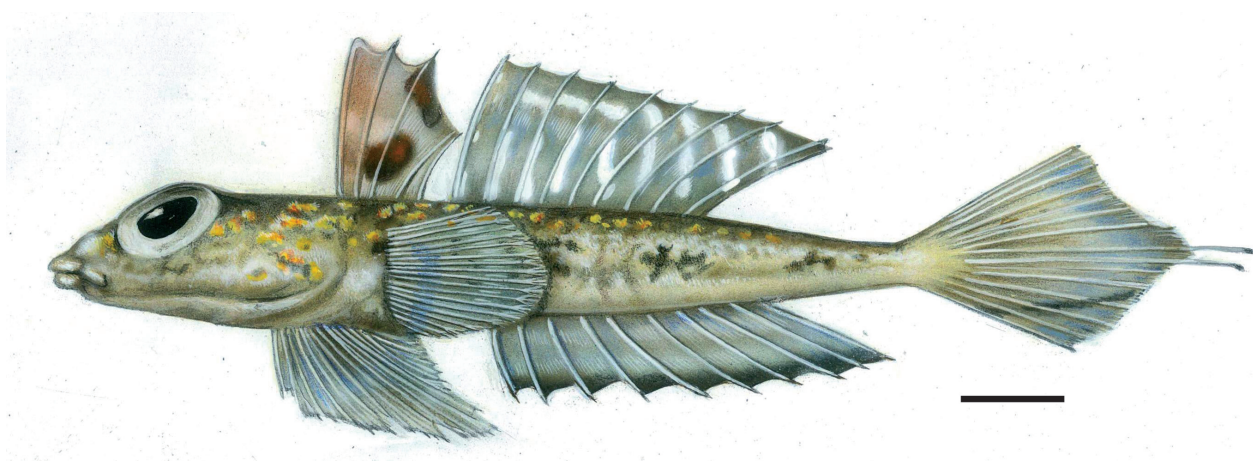
(counted from above). Caudal fin distally slightly pointed, with the two median unbranched rays elongate, with short filaments.

Colour in life (Fig. 1): Head and body beige, ventrally white; thorax with dark grey pigment. Back with irregularly arranged dark grey, white and orange spots. Snout with dark grey pigment spots. Eye dorsally with dark grey pigment. Opercle with small dark grey, white and orange spots. Upper edge of pectoral-fin base surrounded by a semicircular black band. Sides of body with two rows of black blotches below the lateral line, arranged in groups of 2–4. Dorsal side of caudal peduncle with blotches of dark grey pigment. First dorsal fin grey, with a large black blotch basally on second to third membranes surrounded by white areas. Third membrane with a distal black margin. Second dorsal fin white, with vertically orientated oblique dark grey streaks; membranes with a distal grey margin, membrane between the branches of last ray distally black. Anal fin basally light grey, with two white spots on each ray, distal margin with a black streak, tips of fin rays also black. Caudal fin pale, distal parts of uppermost and lowermost rays and membranes white, lower half with a narrow dark grey streak, membrane between median unbranched rays distally dark grey. Pelvic fin white, with two central and a group of distal grey spots. Pectoral fin translucent, without markings.

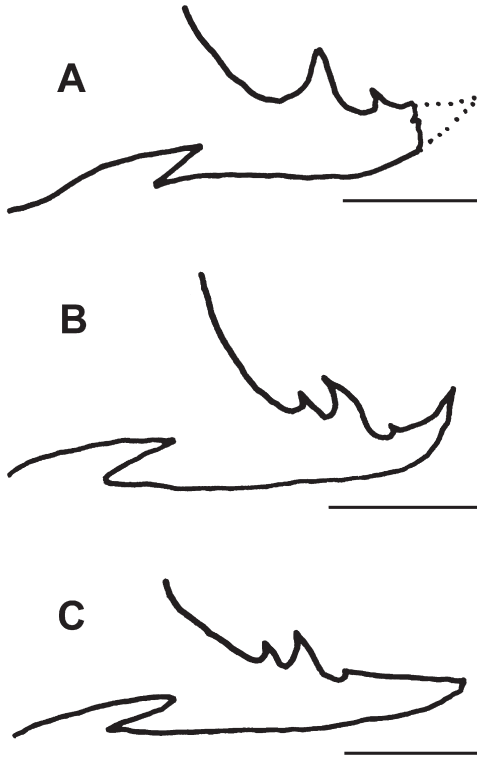
Sexual dimorphism unknown (only the male holotype known).

#### Distribution

The species is only known from the type locality, Israel, Eilat, Gulf of Aqaba (Gulf of Eilat), Red Sea. The holotype was collected at a depth of 410–480 m. The species is probably restricted to deep water of the Gulf of Aqaba (Gulf of Eilat).



**Fig. 1.** *Callionymus profundus* n. sp., colour pattern after collection. – HUI 16989, holotype, male, 65.1 mm SL, Israel, Eilat, Gulf of Aqaba (Gulf of Eilat), Red Sea. Painting by TUVIA KURZ. – Scale: 10 mm.



**Fig. 2.** Left preopercular spines of *Callionymus* spp. – **A.** *C. profundus* n. sp., HUJ 16989, holotype, male, 65.1 mm SL, Israel, Red Sea. **B.** *C. africanus*, RMNH 19984, female, 83.0 mm SL, Somalia Basin seamount. **C.** *C. bentuviai*, HUJ 6675, male, 84.9 mm SL, Eritrea, Red Sea. – Scales: 2 mm.

#### Habitat

This species was trawled from soft bottom habitats. It is probably restricted to the Gulf of Aqaba, which is characterised by an exceptionally high salinity (WYRTKI 1971, FRICKE 1988). The Gulf of Suez has a similar salinity, but it is much too shallow to host this deep water dragonet species. As soft bottom habitats at this depth are very limited in the Gulf of Aqaba, and as the distribution of callionymid fishes of the subgenus *Callionymus* (*Bathycallionymus*) is typically very patchy, with a social structure of small, highly isolated harem groups (FRICKE, 1988), the new species is probably extremely rare.

#### Affinities

The new species is a member of the subgenus *Callionymus* (*Bathycallionymus*) as defined by FRICKE (1981: 350) and NAKABO (1982: 86) (see above in the introduction). It is similar to *Callionymus africanus* (Kotthaus, 1977) (KOTTHAUS 1977: 38, as *Diplogrammus africanus*) from the northwestern Indian Ocean, and *Callionymus bentuviai* Fricke, 1981 (FRICKE 1981: 366, fig. 12) from the southern Red Sea in having the second dorsal and anal fins with a

straight distal margin, the first dorsal fin without filaments and the caudal fin bearing two filaments. Other species of the subgenus have the second dorsal and/or anal fin with convex distal margins, one or more filaments in the first dorsal fin of the male, and one or no filament of the caudal fin. The new species differs from *Callionymus bentuviai* in having just a single dorsal point on the preopercular spine (additional to the small antrorse barb and the main tip; two points in *C. bentuviai*), the large black blotch on the first dorsal fin anteriorly only reaching to second spine, not to first spine (reaching to first spine in *C. bentuviai*), the pelvic fin distally without a dark area, but only with a few dark spots (with a dark area but without dark spots in *C. bentuviai*), and the second membrane of the first dorsal fin of the male not deeply incised (deeply incised in *C. bentuviai*). It is distinguished from *C. africanus* in having just a single dorsal point on the preopercular spine (additional to the small antrorse barb and the main tip; two points in those species; see Fig. 2), in the distally black third membrane of the first dorsal fin (distally pale in *C. africanus*), and the colouration of the second dorsal fin (with vertical dark grey bars in *C. profundus* n. sp.; with 2 horizontal rows of dark spots and 3 rows of white spots in *C. africanus*).

A revised key to callionymid fish species of the Red Sea and western Indian Ocean is presented below to distinguish *Callionymus profundus* n. sp. from potentially co-occurring species. Also, a key to species of the subgenus *Callionymus* (*Bathycallionymus*) is provided to characterise the new species among other related species.

#### Remarks

The type locality of this new species represents the northernmost record of the subgenus *Bathycallionymus*.

In an alternative classification by NAKABO (1982), *Callionymus profundus* n. sp. would be a member of the genus *Bathycallionymus*. Here, we treat *Bathycallionymus* as a subgenus of *Callionymus* (see introduction).

The date of collection of the holotype was erroneously given as 11 Feb. 1993 by BARANES & GOLANI (1993: 309); in fact, it is 11 Feb. 1992.

#### 4 Key to species of Callionymidae of the Red Sea and western Indian Ocean

- |                                                                                                                                    |                           |
|------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 1 Opercle with a free flap of skin .....                                                                                           | 2                         |
| – Opercle without a free flap of skin .....                                                                                        | 7                         |
| 2 Body with lateral fold of skin below LL; lower lip without fleshy papillae; A rays unbranched .....                              | ( <i>Diplogrammus</i> ) 3 |
| – Body without lateral fold of skin below LL; dorsal margin of lower lip with a row of erect fleshy papillae; A rays branched..... | ( <i>Draculo</i> ) 6      |
| 3 Second spine of first dorsal fin longer than first spine of second dorsal fin .....                                              | 4                         |
| – Second spine of first dorsal fin as long as or shorter than first spine of second dorsal fin .....                               | 5                         |

- 4 Body depth 12–13% of SL; pectoral-fin rays 16–17. .... *Diplogrammus gruvelli* Smith, 1963  
 – Body depth 17–18% of SL; pectoral-fin rays 20. .... *Diplogrammus pygmaeus* Fricke, 1981
- 5 First spine of first dorsal fin with a long filament in male; main tip of preopercular spine upcurved; anal fin without distal black margin. .... *Diplogrammus infulatus* Smith, 1963  
 – First spine of first dorsal fin without a filament in male; main tip of preopercular spine straight; anal fin with narrow distal black margin. .... *Diplogrammus randalli* Fricke, 1983
- 6 First dorsal fin with a single spine; second dorsal fin with 11 rays (the last divided at its base); anal fin with 12 branched rays (the last divided at its base) ..... *Draculo celetus* (Smith, 1963)  
 – First dorsal fin with 4 spines; second dorsal fin with 9–10 rays (the last divided at its base); anal fin with 10 branched rays (the last divided at its base) ..... *Draculo maugei* (Smith, 1966)
- 7 Lateral line with numerous long branches above and below; preopercular spine simple, without accessory spines. .... *Paracallionymus costatus* (Boulenger, 1898)  
 – Lateral line mostly unbranched; preopercular spine with one or more accessory spines. .... 8
- 8 Snout shorter than eye diameter; soft D rays branched (in specimens longer than 3 cm); gill opening sublateral; no antrorse spine present at preopercular spine base. .... (*Synchiropus*) 9  
 – Snout equal to, or longer than, eye diameter; soft D rays unbranched; gill opening dorsal; antrorse spine at base of preopercular spine. .... (*Callionymus*) 14
- 9 Preopercular spine with 1 dorsal point additional to main tip. .... 10  
 – Preopercular spine with 2–5 dorsal points additional to main tip. .... 11
- 10 Caudal fin pale or with 1 distal dark bar; caudal fin length 33–40% of SL; second dorsal fin pale or with distal dark bar. .... *Synchiropus monacanthus* Smith, 1935  
 – Caudal fin with 2 dark bars; caudal fin length 27–32% of SL; second dorsal fin spotted. .... *Synchiropus stellatus* Smith, 1963
- 11 Preopercular spine with 2 dorsal points additional to main tip. .... 12  
 – Preopercular spine with 3–5 dorsal points additional to main tip. .... 13
- 12 Main tip of preopercular spine straight; preopercular spine always without small antrorse spines at base; first dorsal fin dark, striped. .... *Synchiropus marmoratus* (Peters, 1855)  
 – Main tip of preopercular spine upcurved; preopercular spine usually with 1–2 small antrorse points at base; first dorsal fin light, with dark blotches. .... *Synchiropus sechellensis* Regan, 1908
- 13 Dorsal spines filamentous in male; lower pectoral-fin base without black spots. .... *Synchiropus postulus* Smith, 1963  
 – Dorsal spines not filamentous in male; lower pectoral-fin base with black spot. .... *Synchiropus minutulus* Fricke, 1981
- 14 Both dorsal and ventral margins of preopercular spine with antrorse spines or serrae. .... 15  
 – Only dorsal margin of preopercular spine with curved points or antrorse serrae (1–2 antrorse spines may be present at base of preopercular spine). .... 17
- 15 Snout densely covered with numerous spines. .... *Callionymus spiniceps* Regan, 1908  
 – Snout without spines (occasionally except for a small preorbital spine). .... 16
- 16 Overeye tentacle present; lower margin of preopercular spine with 1–3 curved points additional to antrorse spine at base. .... *Callionymus muscatensis* Regan, 1905  
 – Overeye tentacle absent; lower margin of preopercular spine with 4–9 curved points additional to antrorse spine at base. .... *Callionymus oxycephalus* Fricke, 1980
- 17 Upper margin of preopercular spine with small antrorse serrae. .... 18  
 – Upper margin of preopercular spine with large curved points (occasionally with one additional antrorse serra). .... 27
- 18 Second dorsal fin with 8 rays (the last divided at its base). 19  
 – Second dorsal fin with 9 rays (the last divided at its base). 22
- 19 Anal fin with 7 rays (the last divided at base). .... 20  
 – Anal fin with 8 rays (the last divided at base). .... 21
- 20 Main tip of preopercular spine upcurved; dorsal margin of preopercular spine with 5–6 small antrorse serrae. .... *Callionymus flavus* Fricke, 1983  
 – Main tip of preopercular spine straight; dorsal margin of preopercular spine with 8–15 small antrorse serrae. .... *Callionymus delicatulus* Smith, 1963
- 21 First spine of first dorsal fin filamentous; anal fin distally black. .... *Callionymus margaretae* Regan, 1905  
 – First dorsal fin without filaments; anal fin pale. .... *Callionymus tenuis* Fricke, 1981
- 22 Anal fin with 9 rays (the last divided at its base); first spine of first dorsal fin in male separate from second spine. .... *Callionymus filamentosus* Valenciennes in Cuvier & Valenciennes, 1837  
 – Anal fin with 8 rays (the last divided at its base); first spine of first dorsal fin in male connected with second spine. .... 23
- 23 First spine of first dorsal fin with a long filament. .... 24  
 – First spine of first dorsal fin without a filament. .... 26
- 24 Lower margin of caudal fin pale. .... *Callionymus aagilis* Fricke, 1999  
 – Lower margin of caudal fin black. .... 25
- 25 Third spine of first dorsal fin distally with black blotch; dorsal margin of preopercular spine with 6–12 small antrorse serrae. .... *Callionymus gardineri* Regan, 1908 (male)  
 – Third spine of first dorsal fin without distal black blotch; dorsal margin of preopercular spine with 3–6 small antrorse serrae. .... *Callionymus margaretae* Regan, 1905
- 26 Anal fin with a distal black bar. .... *Callionymus persicus* Regan, 1905  
 – Anal fin pale. .... *Callionymus gardineri* Regan, 1908 (female)
- 27 First dorsal fin with 3 spines; jaws extremely protractile, forming a broad tube when protracted. .... *Callionymus hindsi* Richardson, 1844  
 – First dorsal fin with 4 spines; jaws moderately protractile, narrow when protracted. .... 28
- 28 Anal fin with 7 rays (the last divided at base). .... *Callionymus stigmatopareius* Fricke, 1981  
 – Anal fin with 8 or 9 rays (the last divided at base). .... 29
- 29 Upper margin of preopercular spine with a small antrorse barb near main tip, and with 1–2 large curved points. .... 30  
 – Upper margin of preopercular spine without a small antrorse barb near main tip, but with one or more large curved points. .... 35
- 30 Caudal fin distally convex or slightly pointed, with 1–2 filaments. .... 31



- Caudal fin distally convex, without filaments. .... 32
- 31 Preopercular spine with 2 curved points (additional to small antrorse barb) on dorsal side; large dark blotch on first dorsal fin anteriorly reaching to first spine; pelvic fin with a distal dark area, but without dark spots. – Southern Red Sea. .... *Callionymus bentuviai* Fricke, 1981
- Preopercular spine with 1 curved point (additional to small antrorse barb) on dorsal side; large black blotch on first dorsal fin anteriorly only reaching to second spine, not to first spine; pelvic fin distally without a dark area, but only with a few dark spots. – Gulf of Aqaba, northern Red Sea. .... *Callionymus profundus* n. sp.
- 32 Second dorsal fin with horizontal rows with white and/or dark blotches. .... *Callionymus africanus* (Kotthaus, 1977) (male)
- Second dorsal fin with vertical black streaks. .... 33
- 33 Black blotch on first dorsal fin on first or second to third membranes; cheeks pale. .... *Callionymus kotthausi* Fricke, 1981
- Black blotch on first dorsal fin only on third membrane; cheeks with spots or suborbital dark streak. .... 34
- 34 Suborbital dark streak present; second half of anal fin black. .... *Callionymus africanus* (Kotthaus, 1977) (female)
- No suborbital dark streak, but many brown blotches encircled with darker brown on cheeks; anal fin pale, distal margin dusky. .... *Callionymus regani* Nakabo, 1979
- 35 Dorsal margin of preopercular spine with 1–2 curved points. .... 36
- Dorsal margin of preopercular spine with 3–7 curved points. .... 37
- 36 Main tip of preopercular spine long, curved; preopercular spine not upcurved at base. .... *Callionymus carebares* Alcock, 1890
- Main tip of preopercular spine short, straight; preopercular spine upcurved at base. .... *Callionymus mascarenius* Fricke, 1983
- 37 Caudal fin elongate, with 2 long median filaments. .... *Callionymus cooperi* Regan, 1908
- Caudal fin distally convex, without filaments. .... 38
- 38 Second spine of first dorsal fin longer than first (may both be filamentous in males). .... *Callionymus erythraeus* Ninni, 1934
- Second spine of first dorsal fin shorter than first. .... 39
- 39 Preopercular spine strongly upcurved at base; male with black blotch surrounded by white posteriorly on first dorsal fin. .... *Callionymus mascarenius* Fricke, 1983
- Preopercular spine only slightly upcurved at base; male without black blotch posteriorly on first dorsal fin. .... *Callionymus marleyi* Regan, 1919
- Second dorsal and anal fins relatively low, with straight distal margins. .... 8
- 3 First spine of first dorsal fin filamentous. .... 4
- First spine of first dorsal fin not filamentous. .... 7
- 4 Second dorsal fin high, first ray about 1.1, fifth ray about 0.8 in head length; preopercular spine with 1 large curved point (additional to 1 small antrorse barb) on its dorsal side. .... *Callionymus altipinnis* Fricke, 1981
- Second dorsal fin relatively low, first ray about 1.0, fifth ray about 0.9 in head length; preopercular spine with 2 curved points (additional to 1 small antrorse barb) on its dorsal side. .... 5
- 5 Caudal fin distally convex, with 1 long filament; filament on first spine of first dorsal fin long, nearly twice as long as second spine. – Taiwan. .... *Callionymus formosanus* Fricke, 1981
- Caudal fin distally convex, with 2 filaments; filament on first spine of first dorsal fin relatively short, not twice as long as second spine. – Indonesia, Australia. .... 6
- 6 First dorsal fin with a large black blotch covering most of third membrane, but without a black blotch on first membrane; second dorsal fin pale, without markings; upper half of pectoral-fin base pale. – Northwestern Australia. .... *Callionymus bifilum* Fricke, 2000
- First dorsal fin with a large black blotch distally on second and third membranes, and a small black blotch distally on first membrane; second dorsal fin with vertical dark streaks; upper half of pectoral-fin base with a dark blotch. – Western Indonesia. .... *Callionymus semeiophor* Fricke, 1983
- 7 Main tip of preopercular spine long and slender; distal half of anal fin black, tips of fin rays white; distal margin of caudal fin regularly shaped; black blotch on third membrane of first dorsal fin relatively large, central in position (not reaching distal margin). .... *Callionymus guentheri* Fricke, 1981
- Main tip of preopercular spine short; anal fin with a distal black streak on each membrane, distal two-thirds of membrane and tips of fin rays dark brown; distal margin of caudal fin irregularly shaped; black blotch on third membrane of first dorsal fin very small, extremely distal in position. .... *Callionymus sokonumeri* Kamohara, 1936
- 8 Caudal fin convex, without filaments. .... 9
- Caudal fin convex or slightly pointed, with 1–2 filaments. .... 16
- 9 Anal fin with a narrow distal yellow margin or colourless; sides of body with a row of indistinct brownish blotches or without blotches. .... 10
- Anal fin with a dark brown or black margin; sides of body with a row of small distinct black blotches. .... 11
- 10 First spine of first dorsal fin with a long filament, more than twice as long as second spine. – Western Indonesia. .... *Callionymus bleekeri* Fricke, 1983
- First spine of first dorsal fin not filamentous, about as long as second spine. – Southwestern Indian Ocean. .... *Callionymus regani* Nakabo, 1979
- 11 Main tip of preopercular spine long and slender. .... *Callionymus kotthausi* Fricke, 1981
- Main tip of preopercular spine short. .... 12
- 12 First spine of first dorsal fin filamentous; pelvic fin distally spotted. .... 13
- First spine of first dorsal fin not filamentous; pelvic fin distally with a dark area, but not spotted. .... 14

##### 5 Key to the species of subgenus *Bathycallionymus* of the genus *Callionymus*

- 1 Dorsal margin of preopercular spine usually without a small antrorse barb additional to large, curved points; head in SL 2.7–3.1. .... *Callionymus carebares* Alcock, 1890
- Dorsal margin of preopercular spine with a small antrorse barb additional to large, curved points; head in SL more than 3.2. .... 2
- 2 Second dorsal and anal fins very high, males with convex distal margins. .... 3

- 13 First spine of first dorsal fin with a relatively long filament, at least 1.5 times as long as second spine; upper half of caudal fin spotted, but without a distal dark bar. – Wallis and Futuna. .... *Callionymus futuna* Fricke, 1998  
 – First spine of first dorsal fin with a relatively short filament, at most 1.2 times as long as second spine; upper half of caudal fin not spotted, but with a small distal dark bar. – New Caledonia. .... *Callionymus kanakorum* Fricke, 2006
- 14 First dorsal fin much higher than second dorsal fin, first spine more than 1.5 times as long as first ray of second dorsal fin. .... *Callionymus kailolae* Fricke, 2000  
 – First dorsal fin only slightly higher than second dorsal fin, first spine not more than 1.2 times as long as first ray of second dorsal fin. .... 15
- 15 Preopercular spine with 1 dorsal point (additional to a small antrorse barb); pectoral-fin base with a large dark brown area; back marbled with olive green in fresh specimens; opercle with large white spots; lower part of caudal fin distally black; second dorsal fin with a basal row of dark blotches. .... *Callionymus whiteheadi* Fricke, 1981  
 – Preopercular spine with 2 dorsal points (additional to a small antrorse barb); pectoral-fin base with two black streaks; back yellowish brown, with white blotches surrounded by semicircular dark bands; opercle with small dark spots; lower part of caudal fin with a broad curved dark band, but distally colourless; second dorsal fin without a basal row of blotches or spots. .... *Callionymus africanus* (Kotthaus, 1977) (female)
- 16 First spine of first dorsal fin with a long filament. .... 17  
 – First spine of first dorsal fin without a filament. .... 19
- 17 Main tip of preopercular spine short, largest point on its dorsal margin with a basal hook; second dorsal fin colourless, with transverse white lines; sides of body with a row of distinct black blotches. .... *Callionymus kaianus* Günther, 1880  
 – Main tip of preopercular spine long and slender, largest point on its dorsal margin without a basal hook; second dorsal fin with rows of blotches; sides of body with a row of indistinct brownish blotches. .... 18
- 18 Anal fin with a dark margin; second dorsal fin with two rows of white blotches and a distal dark margin; main tip of preopercular spine about 2.5–3.0 times as long as largest point on the dorsal side; body with light blotches edged with semicircular dark lines. .... *Callionymus moretonensis* Johnson, 1971  
 – Anal fin pale, without a dark margin; second dorsal fin with a basal and 2–3 more distal rows of dark spots; main tip of preopercular spine about 1.0–1.5 times as long as largest point on the dorsal side; body with minute blackish spots forming rings and blotches. .... *Callionymus ochiaii* Fricke, 1981
- 19 Caudal fin with 2 long filaments which are nearly twice as long as remainder of fin; large dark blotch on first dorsal fin anteriorly reaching to first spine. .... *Callionymus bentuviai* Fricke, 1981  
 – Caudal fin with 1 or 2 relatively short filaments which are not longer than the remainder of the fin; large dark blotch on first dorsal fin in male anteriorly at most reaching to second spine, not to first spine. .... 20
- 20 Preopercular spine with 1 curved point (additional to small antrorse barb) on dorsal side. – Gulf of Aqaba, northern Red Sea. .... *Callionymus profundus* n. sp.  
 – Preopercular spine with 2 curved points (additional to small antrorse barb) on dorsal side. – Indian Ocean or western Pacific. .... 21

- 21 First dorsal fin with a large dark area, with a branch reaching anteriorly to first spine; second dorsal fin with vertical dark streaks. .... *Callionymus semeiophor* Fricke, 1983 (female)  
 – First dorsal fin with a black blotch on third membrane (rarely with an additional blotch on the same membrane), occasionally reaching from second to fourth spines; second dorsal fin with rows of dark and/or white spots (but without vertical dark streaks). .... 22
- 22 Cephalic lateral line in postorbital region with a long branch running downwards; first dorsal fin with a large black blotch basally on the third membrane, with 1–2 branches reaching to second membrane; pectoral-fin base with 2 dark streaks; anal fin with a distal black margin (usually including tips of fin rays); caudal fin without two median transverse black lines; second dorsal fin with a basal, a median and a distal row of light spots and 2 median rows of black spots. .... *Callionymus africanus* (Kotthaus, 1977)  
 – Cephalic lateral line in postorbital region without a long branch; first dorsal fin with a relatively small distal black blotch on the third membrane; pectoral-fin base with a dark area; distal half of anal fin black, tips of fin rays white; caudal fin with two median transverse black lines; second dorsal fin with a basal and a median row of black spots. .... *Callionymus guentheri* Fricke, 1981 (female)

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