

## *Grammonus thielei* (Ophidiiformes: Bythitidae) – a new bythitid cavefish from off Sulawesi, Indonesia

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### ABSTRACT

A new species of the genus *Grammonus* (Ophidiiformes: Bythitidae) is described based on a male, 87 mm SL. It was caught 35 m inside a limestone cave in Tomia, off south-eastern Sulawesi. A comparison to the six hitherto described *Grammonus* species shows that it is most similar to *G. ater* from the Mediterranean. *Grammonus thielei* n. sp. differs in having fewer anal fin rays (41 vs 51–52) and vertebrae (38 vs 40–42), more pectoral fin rays (21 vs 18–19) and a longer head (33 vs 26–28% SL).

KEYWORDS: *Grammonus*, Bythitidae, new species, marine cave, Tomia, Sulawesi.

### INTRODUCTION

In 1998 we received from Mr Werner Thiele, director of Waterworld and Schöner Tauchen, Hall, Austria, a photograph of a fish taken by him in a cave at Tomia, a small island in the Tukang-Besi Archipelago, off south-eastern Sulawesi. The same photograph also reached us through the kindness of Dr Klaus Rützler of the Smithsonian Institution. We recognized the fish as belonging to the family Bythitidae but could not further classify it. We wrote Mr Thiele that a specimen was needed before we could identify the fish. Subsequently we received a specimen caught in the same cave and in addition a short video-film showing the swimming behaviour of another individual. The species belongs to the genus *Grammonus* Gill in Goode and Bean, 1896 and represents a new species which is described below.

**Taxonomy.** The ventrally positioned anterior nostril, few developed rakers on the anterior gill arch, single ventral fin ray, lack of basibranchial tooth patches and presence of a male intromittant organ confirm the assignment of the specimen to the viviparous ophidiiform family, Bythitidae.

Bythitidae is divided into two subfamilies: Bythitinae and Brosmophycinae. According to Cohen and Nielsen (1978: 42) and Nielsen *et al.* (1999: 94) the subfamilies can be separated by the caudal fin being broadly united with the dorsal and anal fins in the former, whereas the caudal fin is free from the dorsal and anal fins, or basally connected, in the latter. Yet Nielsen *et al.* (1999: 112)

pointed out that within the brosmophycine genera *Dermatopsis*, *Dipulus* and *Lucifuga* the caudal fin may be free from or partly connected to the dorsal and anal fins, a condition that is now also found in the bythitine genus *Grammonus*. This calls into question the use of the condition of the caudal fin as the only character for separating the two bythitid subfamilies.

Furthermore, the following combination of characters places the specimen in the genus *Grammonus* (cf. Cohen 1964 and Nielsen *et al.* 1999): body covered with imbricate scales, head partly scaled and not depressed; posterior part of maxilla vertically expanded; palatines edentate; 3–4 developed rakers on anterior gill arch, with short rakers between the developed rakers; precaudal vertebrae 11; some precaudal neural spines truncate.

### TAXONOMY

#### Genus *Grammonus* Gill in Goode and Bean, 1896

#### *Grammonus thielei* n. sp.

Figs 1–3

**Material examined.** HOLOTYPE – ZMUC (Zoologisk Museum, Kobenhavn University, Copenhagen) P771359, SL 87 mm, male, 35 m inside a limestone cave in Tomia, off south-eastern Sulawesi, hand caught, ca. 25 m, July 2002.

**Comparative material examined.** *Grammomus ater* (4 specimens), *G. diagrammus* (6 specimens), *G. robustus* (2 specimens), *G. waikiki* (1 specimen).

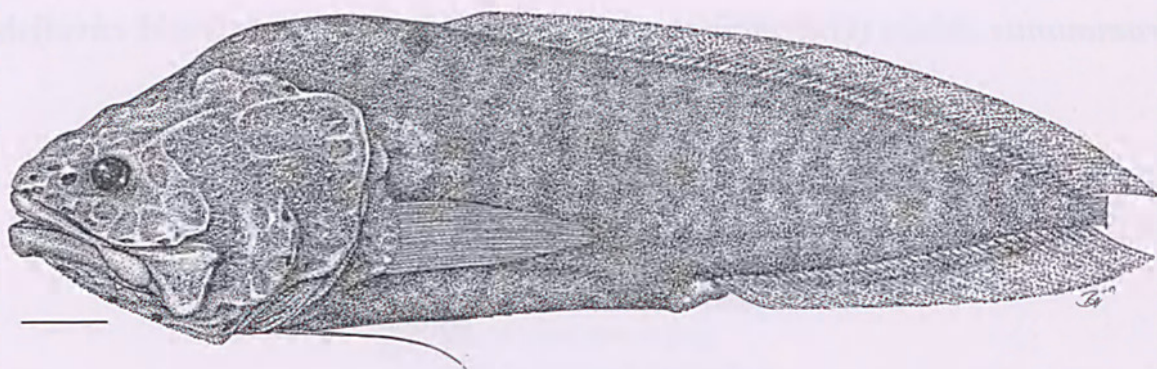


Fig. 1. *Grammonus thielei* n. sp., holotype, ZMUC P771359, SL 87. Caudal fin broken. Scale: 1 cm.

**Diagnosis.** Fin rays in dorsal 66, anal 41, pectoral 21, vertebrae 11+27 (ural elements counted as 1). Head length 33% SL. One large lateral line pore (= posterior supraorbital pore) near angle of opercle. Caudal fin free of dorsal and anal fins.

**Description.** *Meristic characters.* Fin rays in dorsal 66, caudal 12, anal 41, pectoral 21 and pelvic 1; vertebrae 11 + 27 (ural elements counted as 1); anterior dorsal fin ray above vertebra 7; anterior anal fin ray below dorsal ray 26 and vertebra 18; no pseudobranchial filaments; 3–4 developed and 14–16 short rakers on anterior gill arch (total 18–19); ca. 70 lateral line scales (difficult to count).

*Morphometric characters in percentage of standard length (SL 87 mm).* Head length 33.0, head width 20.0, maximum head height 29.0, depth at origin of dorsal fin 27.0, depth at origin of anal fin 19.5, upper jaw length 20.0, expanded posterior upper jaw 7.0, diameter of pigmented eye 3.6, interorbital width 9.1, postorbital length 21.5, predorsal length 39.5, preanal length 63.5, distance from base of ventral to origin of anal fin 38.5, pectoral fin length 20.5, pelvic fin length 19.5.

*General description.* A short and robust fish, the body covered by rather small, imbricate scales; head with scales on chin and dorsum. Head very high and broad, one third of standard length (Fig. 1). Tip of opercular spine blunt. No spines on hind margin of preopercle. No interval between dorsal, caudal and anal fin pterygiophores, but caudal fin free. Origin of dorsal fin above proximal part of pectoral fin; origin of anal

fin well behind midpoint of fish; tip of pectoral behind midpoint of fish; pelvic fin reaches about halfway from its base to anal fin origin. Diameter of pigmented eye half the length of snout. Anterior nostril with short tube placed close to upper lip; the much larger posterior nostril midway between eye and anterior nostril. Upper jaw ends well behind eye; posterior end of maxilla vertically expanded. Gill membranes free from isthmus. Anterior gill arch with three short rakers on upper arm, one developed raker in angle and lower arm with 2–3 developed and 14–16 short rakers. Short rakers between long rakers (Fig. 2). No pseudobranchial filaments. Peritoneum thick and silvery white, testes large, intestine simple and empty. Swimbladder small and thin walled. Penis small, covered by large hood.

*Head sensory pores.* Supraorbital canal with two pores, one above and one below anterior nostril. Infraorbital canal with five pores, two below posterior nostril in a skin-fold close to upper jaw and three behind eye. Mandibular canal with five pores, two near symphysis and three below jaw. Three preopercular pores at posterior margin of preopercle. Many small papillae all over head. Large mucous cavities in rows on mandible, below eye, vertically behind eye and between eye and upper angle of opercle.

*Lateral line.* One large pore near upper angle of opercle (= posterior supraorbital pore). Body lateral line with an upper anterior part of 15 papillae ending above tip of pectorals and a posterior median part of 25 papillae beginning at tip of pectoral and ending at base of caudal fin.

*Sagittal otolith* (Fig. 3). Sagitta very thick, triangular, with height a little more than half its length and with prominent mid-dorsal angle. Sulcus reduced, undivided and without ostial channel.

*Axial skeleton (from radiograph).* Eleven neural spines of which the anterior is 1/3 length of second spine, numbers 2–4 long, pointed and slightly depressed, numbers 5–8 short, truncate and somewhat depressed and numbers 9–11 longer, less truncate and erect. The 26 caudal vertebrae all with slender, pointed neural and haemal spines. Parapophyses on vertebrae 7–11. Pleural and epipleural ribs on vertebrae 3–9.

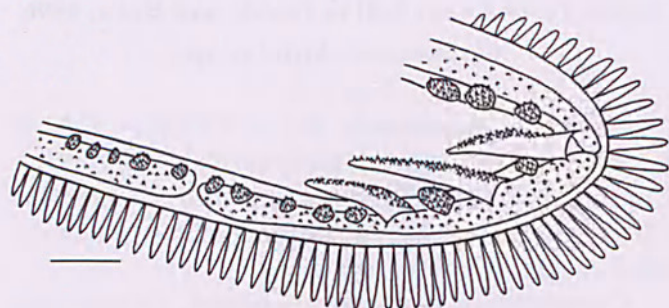


Fig. 2. *Grammonus thielei* n. sp., holotype. Anterior left gill arch. Scale: 2 mm.

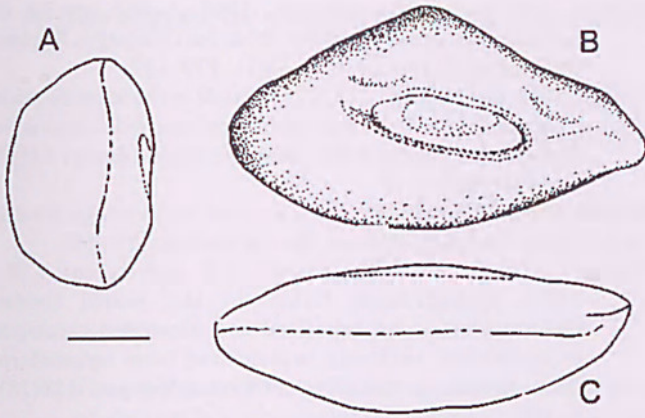


Fig. 3. *Grammonus thielei* n. sp., right sagitta of holotype. A, frontal view. B, median view. C, dorsal view. Scale: 1 mm.

**Dentition.** Premaxillaries with many small, pointed, close-set teeth (granular in texture) along entire length; number of rows decrease posteriorad; posterior half of left premaxilla with pronounced swollen area (Fig. 1) completely covered by teeth of same size as other teeth on premaxillaries. Dentigerous vomer boomerang-shaped with granular teeth medially and somewhat larger teeth distally. Palatines edentate. Dentaries with inner row consisting of rather large, pointed, retrorse teeth; other rows with granular teeth.

**Colour.** Head and body mottled brown with an indistinct dark brown spot on left side just below origin of dorsal fin. Eye dark blue.

**Similarity.** Although on the basis of geographical distribution it might be expected that *G. thielei* was derived from *G. robustus*, a species found throughout the Indo-West Pacific, Table 1 shows that on the basis of meristic characters *G. thielei* is most similar to the Mediterranean *G. ater* (Risso, 1810), both having relatively low counts. *Grammomus thielei* differs from *G. ater* mainly in having fewer anal fin rays (41 vs 51–52) and vertebrae (38 vs 40–42), more pectoral fin rays (21 vs 18–19) and a longer head (33 vs 26–28% SL).

**Biology.** The following is based on observations by Lorenz Mäder and Werner Thiele and a video made by Thiele in a cave leading from a sinkhole at the northern end of the island Tomia, the third island in the Tukang Besi Archipelago. The cave fish was first seen by Mäder in 1996 and since then Thiele and Mäder have observed 20–25 specimens in three different caves and sinkholes that are probably connected at depths between 2 and 30 metres. Water levels in the sinkhole fluctuate with the ocean tides. Temperature ranges from 21 to 25°C. A lens of warmer, low salinity water at the top is floored by a pseudo-bottom of waterlogged vegetation, beneath which the water is cooler, more saline and clearer (resembling a Bahamian sinkhole in which *Lucifuga* was found, as described by Cohen and McCosker, 1998). The fish were most often observed in lightless chambers without current, but a few were seen at the entrance to a cave where they hid beneath rock ledges. They showed no reaction to torchlight and their escape distance was only about 2 cm. They were mostly seen motionless, with only a slight movement of the fins maintaining the fishes' position between the limestone rocks. Males appeared to reach 18 cm total length and females 15 cm. Juveniles are pale, changing to beige as adults.

Cave dwelling bythitid species are found in the following genera: *Grammonus* (5 spp. including *G. thielei*), *Lucifuga* (5 spp.), *Ogilbia* (1 sp.) and *Typhliasina* (1 sp.). All of these species have reduced eyes, not externally visible in some. Many are sparsely or not at all pigmented and all have large mucous cavities on the head. *Grammomus thielei* has small but well developed eyes and well pigmented skin when adult, suggesting that it is a recent arrival to a cave environment.

**Distribution.** Known only from the type locality, a limestone cave-system in Tomia an island off south-eastern Sulawesi.

**Etymology.** Named after Werner Thiele who was the first to photograph and catch a specimen of this new species.

Table 1. Diagnostic characters of *Grammonus* species.

|                                                   | Locality      | No.*<br>of spms. | Dorsal<br>fin rays | Anal<br>fin rays | Pectoral<br>fin rays | Vertebrae | Lat. line<br>pores on<br>opercle | Head<br>length in<br>% SL |
|---------------------------------------------------|---------------|------------------|--------------------|------------------|----------------------|-----------|----------------------------------|---------------------------|
| <i>G. thielei</i> n. sp.                          | Sulawesi      | 1                | 66                 | 41               | 21                   | 38        | 1                                | 33                        |
| <i>G. ater</i> (Risso, 1810)                      | Mediterranean | 3                | 68–74              | 51–52            | 18–19                | 40–42     | 1                                | 26–28                     |
| <i>G. claudei</i> (Torre and Huerta, 1930)        | Trop. W. Atl. | 6                | 82–87              | 64–69            | 23–25                | 41–43     | 4                                | 29–31                     |
| <i>G. diagrammus</i> (Heller and Snodgrass, 1903) | Trop. E. Pac. | 26               | 95–115             | 76–91            | 24–29                | 49–53     | 1                                | 25–28                     |
| <i>G. longhursti</i> (Cohen, 1964)                | Trop. E. Atl. | 5                | 83–89              | 58–61            | 24–25                | 44–45     | 1                                | 25–27                     |
| <i>G. robustus</i> Smith and Radcliffe, 1913      | Afr. – Japan  | 9                | 75–87              | 50–62            | 23–25                | 44–47     | 1                                | 28–31                     |
| <i>G. waikiki</i> (Cohen, 1964)                   | Hawaii        | 2                | 96–98              | 71–76            | 25–26                | 45–48     | 0                                | 26–28                     |

\*Number of specimens from both literature and specimens examined

## ACKNOWLEDGMENTS

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