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A new species of *Augeneria* (Polychaeta: Lumbrineridae) from deep waters of the Aegean Sea (eastern Mediterranean)

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Abstract

A new species of Lumbrineridae, *Augeneria profundicola* sp. nov. is described based on one specimen taken from 950 m depth on muddy bottom off Gökçeada Island (northern Aegean Sea). This new species is characterized by having seven small nuchal antennae arranged in a circle line on the prostomium and bidentate maxilla II. The morphological features of this species were compared with those of all *Augeneria* species described so far. A taxonomic key to all *Augeneria* species is also provided.

Keywords: Lumbrinerid, description, taxonomy, deep sea, northern Aegean Sea.

Introduction

The family Lumbrineridae Shmarda, 1861 is represented by 10 genera (Abyssoninoe Orensanz, 1990; Augeneria Monro, 1930; Gallardoneris Carrera-Parra, 2006; Hilbigneris Carrera-Parra, 2006; Lumbricalus Frame, 1992; Lumbrinerides Orensanz, 1973; Lumbrineriopsis Orensanz, 1973; Lumbrineris Blainville, 1828; Ninoe Kinberg, 1865; Scoletoma Blainville, 1828) and 33 species in the Mediterranean (Coll et al., 2010; D'Alessandro et al., 2014; Bertasi et al., 2014; Gómez et al., 2015). A total of 17 species belonging to 7 genera (*Hilbigneris*, Lumbricalus, Lumbrinerides, Lumbrineriopsis, Lumbrineris, Ninoe and Scoletoma) were found along the coasts of Turkey (Cinar et al., 2014). Two lumbrinerid species, namely, Lumbrineris perkinsi (Carrera-Parra, 2001) and Scoletoma debilis (Grube, 1878), were considered as alien species in the Mediterranean Sea. Lumbrineris perkinsi was regarded as a Lessepsian invader (i.e. a species that has migrated from the Red Sea to the Mediterranean via the Suez Canal) and densely occurred along the southern coast of Turkey (Çinar, 2009). Scoletoma debilis was first reported from the Sea of Marmara by Rullier (1963), but was later considered as a questionable alien species by Çinar *et al.* (2005).

Among the genera of Lumbrineridae, *Augeneria* is mainly characterized by having short nuchal antennae on the prostomium, four pairs of maxillae, pigmented maxilla IV (MIV) with a whitish central area and the mandible divergent at its anterior and posterior ends (Carrera-Parra, 2006). This genus was previously considered as a synonym of the genus *Lumbrineris* by Fauchald (1970), as some species of *Ninoe* and *Lumbrineris* also have nuchal antennae on the prostomium. Then, Orensanz (1973) resurrected this genus based on the morphology of the maxillary apparatus and mandibles. Carrera-Parra (2006) amended certain characters of the maxillary apparatus of the genus and clarified its taxonomic position within Lumbrineridae.

The genus Augeneria includes 7 valid species in the world's oceans; A. albidentata (Ehlers, 1908) (originally described from Agulhas Bank, South Africa at 117 m), A. algida (Wirén, 1901) (from West Spitsbergen, Norway, Arctic Ocean at 1780 m), A. bidens (Ehlers, 1887) (from Florida, Atlantic Ocean at 348-642 m), A. polytentaculata Imajima and Huguchi, 1975 (from Japan, Pacific Ocean at 100 m), A. riojai Aguirrezabalaga and Carrera-Parra, 2006 (from the Bay of Biscay, Atlantic Ocean at 480-580 m), A. tentaculata Monro, 1930 (from Signy Island, Antarctic Ocean at 244-344 m) and A. verdis Hutchings and Murray, 1984 (from the Tasman Sea, Pacific Ocean at 4-12 m). The validity of A. dayi within the genus Augeneria seems to be questionable, as it lacks composite hooded hooks on the parapodia. The genera with antennae on the prostomium and lacking composite hooded hooks are Kuwaita Mohammad, 1973; Cenogenus Chamberlin, 1919 and Sergioneris Carrera-Parra, 2006. The original description of A. dayi from Sri Lanka by de Silva (1965) was poor, lacking a proper description of the morphology of the maxillary apparatus, which is one of the diagnostic characters of the genus Augeneria. Therefore, a re-description of the species, based on type specimens, is required to determine which genus it in fact belongs to. Orensanz (1973; 1990) mentioned that Lumbrineris meteorana Augener, 1931 seems to be morphologically similar to Augeneria in having a large and rounded MIV with a dark edge and a pale middle part like the other species of Augeneria. However, it differs from the Augeneria species in lacking nuchal antennae and a divergent mandible. Therefore, in this study, this species was not considered within Augeneria, and its taxonomic placement requires re-consideration within the genus. Among *Augeneria* species, only *A. tentaculata* has been reported from the Mediterranean Sea (Alboran Sea) at 1491 m depth (Miura, 1980).

In this paper, we describe a new species of *Augeneria*, *Augeneria profundicola* sp. nov., based on one specimen collected in deep-water off Gökçeada (northern Aegean Sea). Also, a taxonomic key to all the species of the genus is provided.

Material and Methods

One specimen of *Augeneria profundicola* sp. nov. was collected by a baited trap set on a muddy bottom at 950 m. depth off Gökçeada Island in the northern Aegean Sea (40°19'19"N-25°38'35"E) in October 2014 (Fig. 1). In the field, the specimen was fixed with 4% formaldehyde solution. At the laboratory, the specimen was washed with tap water and then preserved in 70% ethanol.

In order to examine details of both the maxillae and the mandible under a compound microscope, an anterodorsal dissection was made to extract the maxillary apparatus. The body length, length of the head and the first 10 chaetigerous segments (L10) and the width at chaetiger 10 (excluding parapodia and chaetae) were measured with an ocular micrometer. Photographs of the general view of the specimen were taken using a digital camera (Nikon, P7000) attached to a stereo-microscope and the chaetal images were taken by a digital imaging system (Nikon, DS-Fi2) installed on a compound microscope using a DIC (Differential Interference Contrast) attachment.

The holotype of *Augeneria profundicola* sp. nov. was deposited at the Museum of the Faculty of Fisheries (ESFM), Ege University, Turkey.

Taxonomic Account

Class Polychaeta Grube, 1850 Order Eunicida Dales, 1962 Family Lumbrineridae Schmarda, 1861 Genus *Augeneria* Monro, 1930 *Augeneria profundicola* sp. nov. (Figures 2-4)

Type Material. Holotype. ESFM-POL/2014-616, Gökçeada Island, Aegean Sea, 19.10.2014, 40°19'19" N, 25°38'35" E, at 950 m, on mud.

Description. Holotype incomplete with 55 chaetigers, 34.6 mm long, 1.7 mm wide, L10= 5.7 mm. Body cylindrical, pale pink coloured, slightly tapering posteriorly. Prostomium conical, as long as wide, with seven small nuchal antennae arranged in a circle line (Figs. 2A-C, Fig. 3A). Peristomium shorter (0.65 mm) than prostomium (0.9 mm); with two rings, anterior ring (0.45 mm)

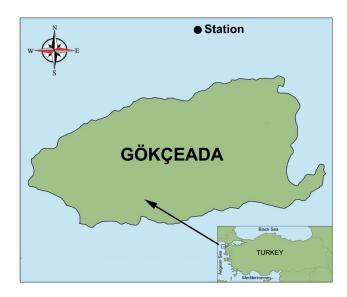


Fig. 1: The map showing the location of sampling site.

more than twice as long as posterior ring (0.2 mm); separation between rings distinct dorsally and ventrally. All parapodia well developed; first three parapodia smaller than following ones. Anterior parapodia approximately as long as 1/7 of anterior segment's width; posterior parapodia as long as 1/5 of posterior segment's width. Prechaetal lobe inconspicuous on parapodia 1–9; like a conical projection on parapodia 10 to 14; digitiform, as long as postchaetal lobe from parapodia 14 towards posterior

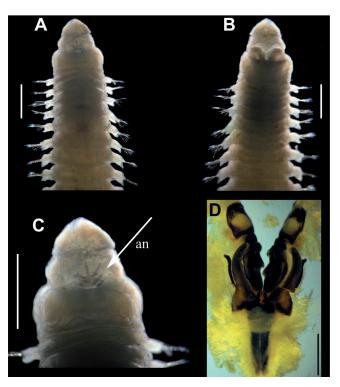


Fig. 2: Augeneria profundicola (ESFM-POL/2014-616), a. Anterior part, dorsal, b. anterior part, ventral, c. General view of prostomium and nuchal antennae, d. maxillary apparatus (an: antennae; Scale bars; a, b: 3 mm; c: 1 mm; d: 500 μm).

end (Figs. 3B-D; Figs. 4A-C). Postchaetal lobes welldeveloped in all parapodia; conical on first three parapodia; digitiform, longer than prechaetal lobe between parapodia 4 and 14; digitiform, as long as prechaetal lobe from parapodia 14 towards posterior end (Figs. 3B-D; Figs. 4A-C). Chaetae including composite multidentate hooded hooks, simple multidentate hooded hooks and limbates. Composite multidentate hooded hooks present on chaetigers 1–18, having short blade (~400 µm) and a distinct main fang with 4-5 teeth of similar size (Fig. 3F, Fig. 4D). Simple multidentate hooded hooks present from chaetiger 19 to posterior end, with a short hood and distinct main fang with up to 6 teeth (Fig. 3G, Fig. 4E). Dorsal and ventral limbate chaetae only present between chaetiger 1 and 18 (Fig. 3H, Fig. 4F). Aciculae yellow, aristate, up to three in anterior chaetigers and one and reddish in posterior ones (Figs. 3B-C). Maxillary apparatus with four pairs of maxillae (Fig. 2D; Fig. 3E); maxillary carriers slightly longer than MI; MI forceps-like with expanded basal part; MII with only two teeth; MIII edentate, arcuate; MIV edentate with a whitish central area and pigmented peripheral line. Mandible divergent at both its anterior and posterior ends.

Etymology. The name was chosen to indicate the deep water existence of the species from the Latin *profundus* meaning deep and the suffix cola for dweller.

Type Locality. Gökçeada Island, Aegean Sea.

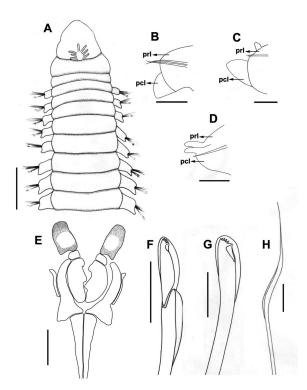


Fig. 3: Augeneria profundicola (ESFM-POL/2014-616), a. Anterior part, dorsal, b. Parapodium 1, c. Parapodium 12, d. Parapodium 40, e. Maxillary apparatus, f. Composite hooded hook, chaetiger 1, g. Simple hooded hook, chaetiger 40, h. Limbate chaeta, chaetiger 13 (prl: prechaetal lobe, pcl: postchaetal lobe; scale bars; a:3 mm; b, c, d: 200 μm; e: 500 μm; f, g, h: 100 μm).

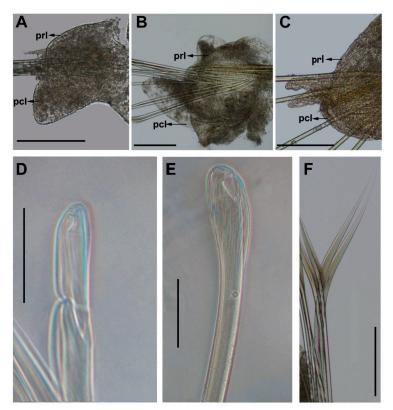


Fig. 4: General view of parapodia and chaetae of Augeneria profundicola (ESFM-POL/2014-616) a. Parapodium 1, b. Parapodium 12, c. Parapodium 40, d. Composite hooded hook, chaetiger 1, e. Simple hooded hook, chaetiger 40, f. Limbate chaetae, chaetiger 13 (prl: prechaetal lobe, pcl: postchaetal lobe; scale bars; a, b, c, f: 200 μm; d, e: 100 μm).

Table 1. The comparison of main diagnostic features of all species of *Augeneria*.

	Prosto- mium	Number of nuchal antennae	Prechaetal lobe	Postchaetal lobe	Composite hooks	Simple hooks	Aciculae	Maxillary formula	Reference
Augeneria profundicola sp. nov.	Conical, as long as wide	7	Inconspicuous on parapodia 1-9; like a conical projection on parapodia 10- 14; digitiform on remaining parapodia	Conical on first three parapodia; digitiform on remaining parapodia	Present on chaetigers 1-18, with short blade, with up to five teeth	Present from chaetiger 19, with short hood, with up to six teeth	Yellow, aristate, three in anterior parapodia, reddish, one in posterior ones.	MI:1+1; MII:2+2; MIII:1+1; MIV:1+1	Present study
A. albidentata	Conical and pear- shaped, longer than wide	3	Rounded on parapodia 1-22; digitiform on remaining parapodia	Digitiform in anterior and posterior parapodia	Present on chaetigers 1-13-25, with long blade with up to six teeth	Present from chaetiger 14-26, with short hood, with up to seven teeth	Yellow	MI:1+1; MII:2+2; MIII:1+1; MIV:1+1	Ehlers, 1908
A. algida	Conical, slightly longer than wide	3	Inconspicuous along body	Conical on parapodia 1-6; more developed (elongated) on remaining parapodia	Present on chaetigers 1-12, with long blade with up to seven teeth	Present from chaetiger 13, with short hood, with up to seven teeth	Yellow, aristate, three in anterior parapodia, one in posterior ones.	MI:1+1; MII:3+3; MIII:1+1; MIV:1+1	Wirén, 1901; Aguirreza- balaga and Carrera- Parra, 2006
A.bidens	Oval, longer than wide	3	Short on anterior parapodia; slightly longer on posterior parapodia	Rounded and digitiform on anterior parapodia; digitiform on posterior parapodia	Present on chaetigers 1 to 7-15, with short blade with seven teeth	Present from chaetiger 8-16, with long hood, with up to five teeth	Yellow	MI:1+1; MII:3+3; MIII:1+1; MIV:1+1	Ehlers, 1887; Carrera- Parra, 2001
A. polytenta- culata	Conical, as long as wide	7	Truncated and short on anterior parapodia; like triangular lamellae on posterior parapodia	Auricular on anterior parapodia; elongated and directed outward on posterior parapodia	Present on chaetigers 1-20, with long blade with seven teeth	Present from chaetiger 14, with long hood, with up to seven teeth	Yellow, aristate, two-three in anterior parapodia, three in posterior ones	MI:1+1; MII:3+3; MIII:1+1; MIV:1+1	Imajima and Higuchi, 1975
A. riojai	Conical, as long as wide	8	Inconspicuous on parapodia 1-7; digitiform on remaining parapodia	Conical on parapodia 1-4; digitiform on remaining parapodia	Present on chaetigers 1-19, with short blade with up to seven teeth	Present from chaetiger 20, with short hood, with up to eight teeth	Black, aristate, five in anterior parapodia, three in posterior ones	MI:1+1; MII:3+3; MIII:1+1; MIV:1+1	Aguirreza- balaga and Carrera- Parra, 2006
A. tentaculata	Rounded to oval	3	Truncated along body	Subtriangular on anterior parapodia; pointed on posterior parapodia	Present from anterior chaetigers, with short blade, with five teeth	Present from median chaetigers, with short hood, with four to five teeth	Hazel	MI:1+1; MII:3+3; MIII:2+2; MIV:1+1	Monro, 1930; Orensanz, 1973
A. verdis	Bluntly conical	3	Digitiform on anterior parapodia, elongated on posterior parapodia	Digitiform on anterior parapodia; elongated on posterior parapodia	Present on chaetigers 1-17, with short blade	Present from chaetiger 12, with short hood, with up to eight teeth	Yellow	MI:1+1; MII:3+3; MIII:1+1; MIV:1+1	Hutchings and Murray, 1984

Discussion. Augeneria species mainly occur on soft substratum in deep-waters. They are generally found at depths deeper than 100 m. The species already reported from depths deeper than 500 m are A. algida and A. riojai. However, A. verdis was found in shallow-water benthic environments (sandy mud and shell fragments at 7-12 m depth) in the Tasman Sea (Hutchings and Murray, 1984).

The main differences between A. profundicola sp. nov., and the other species of Augeneria are shown in Table 1. The number of nuchal antennae on the prostomium is one of the diagnostic characters that are used to distinguish the species within the genus. Five species (Augeneria albidentata, A. algida, A. bidens, A. tentaculata and A. verdis) have only three antennae on the prostomium, whereas A. polytentaculata has a prostomium with seven nuchal antennae and A. riojai with eight nuchal antennae. Augeneria profundicola sp. nov. resembles A. polytentaculata and A. rojai in having several small nuchal antennae on the posterior part of the prostomium, but it mainly differs from them in having bidentate MII. Augeneria profundicola sp. nov. also close to A. albidentata by having bidentate MII but differs in having seven nuchal antennae. In addition, A. profundicola sp. nov. has yellow (anterior) and reddish (posterior) aciculae and composite hooded hooks with distinct main fang with 5 short teeth of similar size, whereas A. riojai has black aciculae and composite hooded hooks with 7 short teeth of similar size, and A. polytentaculata has yellow aciculae and composite hooded hooks with 7 short teeth of similar size. Moreover, the nuchal antennae on the prostomium of A. riojai and A. polytentaculata are arranged in two rows, but those of A. profundicola sp. nov. are arranged in a circle. Although Augeneria profundicola sp. nov. has composite hooks with short blade like A. riojai, A. tentaculata and A. verdis, the new species has composite hooks with distinct main fang before smaller teeth differently from others.

Key to all species of Augeneria

1-MII with two teeth
MII with three teeth
2-Prostomium with three nuchal antennae;
postchaetal lobes digitiform in anterior and
posterior parapodiaAugeneria albidentata
Prostomium with seven nuchal antennae;
postchaetal lobes conical on first three
parapodia; digitiform on remaining
parapodia
r r r r r r r r -
3-Prostomium with three nuchal antennae
3-Prostomium with three nuchal antennae4
3-Prostomium with three nuchal antennae4 Prostomium with more than three nuchal antennae7
3-Prostomium with three nuchal antennae
3-Prostomium with three nuchal antennae

Postchaetal lobes otherwise in anterior parapodia.....6

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