Mediterranean Marine Science

Vol 17, No 3 (2016)

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doi: 10.12681/mms.1695

Research Article

Mediterranean Marine Science
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS
The journal is available on line at http://www.medit-mar-sc.net
DOI: http://dx.doi.org/10.12681/mms.1695

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

G. KURT-SAHIN[1], M. E. ÇINAR[2] and O. GONULAL[3]

[1] Sinop University, Faculty of Arts and Sciences, Department of Biology, 57000, Sinop, Turkey
[2] Ege University, Faculty of Fisheries, Department of Hydrobiology, 35100, Bornova, Izmir, Turkey
[3] Istanbul University, Faculty of Fisheries, Department of Gökçeada Marine Research, 17000, Çanakkale, Turkey

Corresponding author: gkurtsahin@sinop.edu.tr

Handling Editor: Carlo Bianchi

Received: 3 Arpil 2016; Accepted: 16 July 2016; Published on line: 7 November 2016
urn:lsid:zoobank.org:pub:DCDB42C8-D97B-45CB-9968-027F7F2DB654

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 (Çinar *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 antero-dorsal 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

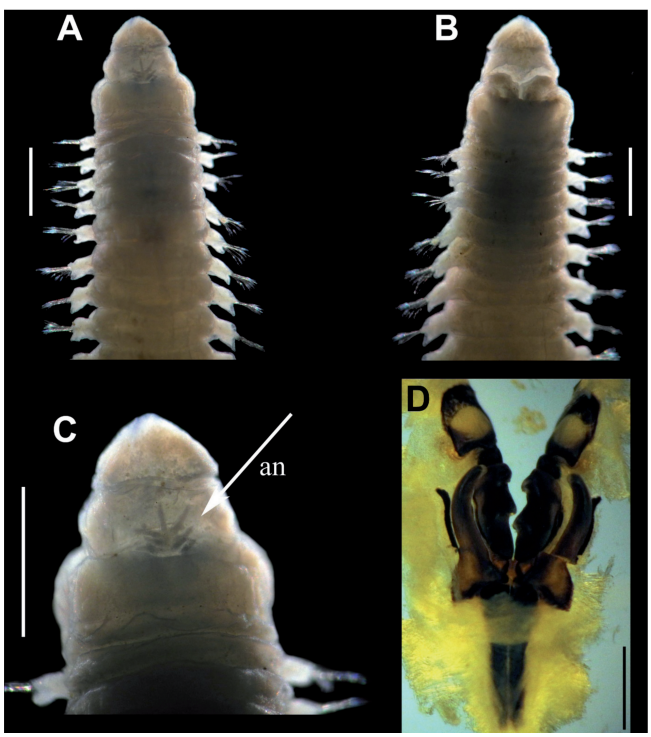

Fig. 2: *Augeneria profundicola* (ESFM-POL/2014-616), a. Anterior part, dorsal, b. anterior part, ventral, c. General view of prostomium and nuchal antennae, d. maxillary apparatus (an: antennae; Scale bars; a, b: 3 mm; c: 1 mm; d: 500 µm).

end (Figs. 3B-D; Figs. 4A-C). Postchaetal lobes well-developed 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.

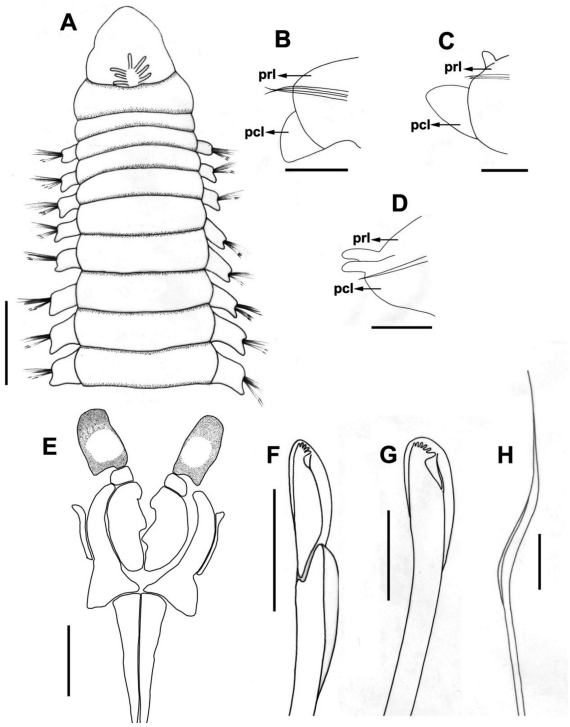

Fig. 3: *Augeneria profundicola* (ESFM-POL/2014-616), a. Anterior part, dorsal, b. Parapodium 1, c. Parapodium 12, d. Parapodium 40, e. Maxillary apparatus, f. Composite hooded hook, chaetiger 1, g. Simple hooded hook, chaetiger 40, h. Limbate chaeta, chaetiger 13 (prl: prechaetal lobe, pcl: postchaetal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

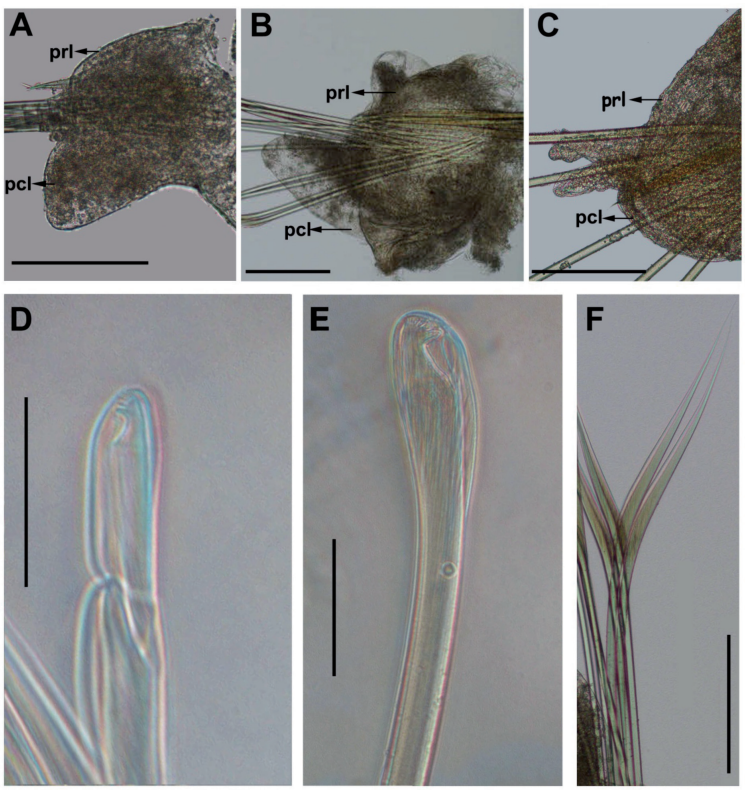

Fig. 4: General view of parapodia and chaetae of *Augeneria profundicola* (ESFM-POL/2014-616) a. Parapodium 1, b. Parapodium 12, c. Parapodium 40, d. Composite hooded hook, chaetiger 1, e. Simple hooded hook, chaetiger 40, f. Limbate chaetae, chaetiger 13 (prl: prechaetal lobe, pcl: postchaetal lobe; 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 2
MII with three teeth 3
2-Prostomium with three nuchal antennae; postchaetal lobes digitiform in anterior and posterior parapodia .....*Augeneria albidentata*
Prostomium with seven nuchal antennae; postchaetal lobes conical on first three parapodia; digitiform on remaining parapodia..... *Augeneria profundicola* sp. nov.
3-Prostomium with three nuchal antennae.....4
Prostomium with more than three nuchal antennae....7
4-Composite hooded hooks with short blade.....5
Composite hooded hooks with long blade .....*Augeneria algida*
5-Postchaetal lobes always digitiform in anterior parapodia.....*Augeneria verdis*
Postchaetal lobes otherwise in anterior parapodia.....6
6-Postchaetal lobes rounded and digitiform in anterior parapodia; prechaetal lobes short on anterior parapodia and slightly longer on posterior parapodia .....*Augeneria bidens*
Postchaetal lobes subtriangular in anterior parapodia; prechaetal lobes truncated along body.....*Augeneria tentaculata*
7- Acicula black ..... *Augeneria riojai*
Acicula yellow ..... *Augeneria polytentaculata*

Acknowledgement

We thank Dr. Derya Urkmez (Sinop University) for drawing the new species. This work was supported by the Scientific Research Projects of Istanbul University, Project Number 32622.

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