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A New Species of \textit{Euzonus} (Polychaeta: Opheliidae) from Subtidal Zones in Japan

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\textbf{ABSTRACT}—A new opheliid polychaete, \textit{Euzonus japonicus} sp. nov., is described. This species was collected from subtidal zones in Japanese coasts, while most \textit{Euzonus} species inhabit intertidal sandy beaches. \textit{E. japonicus} sp. nov. is morphologically most similar to another subtidal species, \textit{E. flabelliferus} (Ziegelmeier, 1955) collected from northern Europe, but different from that in the form of branchiae. They share a unique characteristic on setiger 10, i.e., a pair of lateral transverse rows of conical cirri, instead of a pair of lateral smooth ridges that are common to all intertidal \textit{Euzonus} species.

\textbf{Key words:} taxonomy, new species, Polychaeta, Opheliidae, subtidal habitat

\textbf{INTRODUCTION}


Most \textit{Euzonus} species inhabit intertidal sandy beaches consisting of well-sorted, medium to fine sands (Okuda, 1934; McConnaughey and Fox, 1949; Dales, 1952; Probert, 1976; Kemp, 1988; Buzhinskaja, 1991; Jaramillo \textit{et al.}, 1993; Jaramillo, 1994; Hartmann-Schröder and Parker, 1995; Souza and Gianuca, 1995). However, \textit{E. flabelliferus} was collected from subtidal zones in the North Sea and the White Sea (Ziegelmeier, 1955; Tzetlin, 1978; Hartmann-Schröder, 1996), and \textit{E. profundus} was collected from an abyssal depth of 4080 m, southeast off the Cape Horn (Hartman, 1967). The subtidal species, \textit{E. flabelliferus}, has a unique morphological characteristic on setiger 10, i.e., a pair of lateral transverse rows of conical cirri, while all intertidal species have a pair of lateral smooth ridges on setiger 10 instead of conical cirri.

In East Asia including the Far East Region of Russia (Annenkova, 1935; Uschakov, 1955), northern Japan (Okuda, 1934, 1936; Imajima and Hartman, 1964), and the Chinese coast of the Yellow Sea (Dejian and Ruping, 1988), three intertidal species of the genus \textit{Euzonus}. \textit{E. arcticus}, \textit{E. ezoensis} and \textit{E. dillonensis} have been recorded, but no subtidal species has been recorded. \textit{Thoracophelia yasudai} described by Okuda (1934) from Japanese coast of the Sea of Japan was regarded as a junior synonym of \textit{E. arcticus} by Imajima and Hartman (1964).

In the course of our examination of Japanese opheliid polychaetes, we found a species belonging to the genus \textit{Euzonus} from subtidal habitats. This species is similar to \textit{E. flabelliferus} in both the unique morphological characteristic on setiger 10 and the subtidal habitat, but different from that in the form of branchiae. In the present paper, we describe this species as new to science and as the second subtidal species of the genus \textit{Euzonus}.

\textbf{MATERIALS AND METHODS}

Specimens were collected using a bottom sampler from subtidal sandy bottoms at four collection sites in Japan (Fig. 1). These worms were fixed in 10% formalin for more than 24 hr, rinsed in freshwater and transferred to 80% ethanol for preservation, except for specimens collected from off Yura Beach, Miyazu in 25 September 2001, which were fixed in 100% ethanol for future DNA analysis. For the preserved specimens, body length (BL) and body height (BH) at setigers 5 and 15 were measured. The characteristics of lat-
Fig. 1. Map showing location of collection sites in Japan. a: Oura Bay, Shimoda, and off Yumigahama Beach, Minami-izu, Izu Peninsu- 
a. b: Off Yura Beach, Miyazu. c: Tomioka Bay, Reihoku, Amakusa-Shimoshima Island.

eral cirri and branchiae were examined basically on the left side of 
the body except for some injured specimens. Drawings were made 
with a camera lucida and pictures were taken with a digital camera 
through a binocular microscope. The type materials are deposited 
in the National Science Museum, Tokyo (NSMT), Coastal Branch of 
Natural History Museum and Institute, Chiba (CMNH), the Senckenberg Museum, Frankfurt/M. (SMF), Zoological Museum, Univer-
sity of Copenhagen (ZMUC), and the United States National 

SYSTEMATICS

Family Opheliidae Malmgren, 1867
Genus Euzonus Grube, 1866

Euzonus japonicus sp. nov.
Figs. 2–3

Euzonus sp. 1: Nishi et al., 2001: 256.

Type material. Holotype (NSMT-Pol-H459, BL: 13 mm) 
and 4 paratypes (CMNH-ZW001939, SMF-13240, ZMUC, 
USNM-1014014, BL: 7–15 mm): subtidal sandy bottom, 
depth of 15 m, Oura Bay (34°39′N, 138°57′E), Shimoda, Izu 
All materials complete.

Other material examined. Subtidal sandy bottom, 
depth of 11.5–16 m, off Yumigahama Beach (34°37′55″N, 
138°53.8′E), Minami-izu, Izu Peninsula, Shizuoka Prefec-
ture, 25 May 2000, coll. R. Ueshima, 7 specimens (BL: 11– 
16 mm). Subtidal sandy bottom, depth of 3–5 m, off Yura 
Beach (35°31′N, 135°17′E), Miyazu, Kyoto Prefecture, 20 
August 1973, coll. I. Hayashi, 10 specimens (BL: 4–11 mm); 
25 September 2001, coll. T. Misaka, 7 specimens (BL: 8–18 
mm). Subtidal fringe of intertidal sandflat, Tomioka Bay 
(32°31′N, 130°02′E), Reihoku, Amakusa-Shimoshima Island, 
Kumamoto Prefecture, 14 June 1999, coll. A. Tamaki, 6 spec-
imens (BL: 8–11 mm). All materials complete.

Diagnosis. Pair of lateral transverse rows of 6–11 dor-
sal and 2–4 ventral conical cirri present on setiger 10. Fif-
teen pairs of branchiae present, occurring on setigers 12 to 
Pygidium lacking triangular midventral anal plate. Each lat-
eral lobe of pygidium fringed with 7–12 cirri. Midventral anal 
cirrus present as tiny round protrusion between lateral 
lobes, often obscure.

Description of the holotype. Body fusiform, divided 
into three distinct regions: cephalic region consisting of 
small pointed prostomium and 2 setigers; inflated thoracic 
region consisting of 8 setigers, separated from cephalic 
region by constriction behind setiger 2; abdominal region 
consisting of 22 setigers and pygidium, separated from tho-
racic region by swollen setiger 10; total of 32 setigers (Figs. 
2a and 3a). Longitudinal midventral groove present, shallow 
in thoracic region, deep in abdominal region; pair of longitudi-
dinal lateral grooves present in abdominal region. Pair of 
dorsolateral nuchal grooves present in cephalic region. Ven-
tral mouth slit present in cephalic region, proboscis eversi-
able. Prostomial eyes absent.

Pair of lateral transverse rows of 11 dorsal and 3 ventral 
conical cirri present on setiger 10 (last thoracic setiger) 
(Figs. 2b and 3c). Ventral conical cirri present on setigers 9 
to 25: 3 cirri on setigers 9 to 12, 2 cirri on setigers 13 to 15, 
and single cirrus on setigers 16 to 25, decreasing gradually 
to posterior setigers in size.

15 pairs of branchiae present, occurring on setigers 12 
to 26 (Figs. 2a, c and 3a, b, e); branchiae palmatifid with 4– 
7 finger-shaped branches.

Parapodia biramous, minute. Segmental eyes absent. 
Notosetae and neurosetae all simple capillary setae, arising 
from slightly posterior to each parapodial lobe. Notosetae 
longer than neurosetae at all setigers, except for last 6 set-
igers (setigers 27 to 32) where notosetae and neurosetae 
equal in length. Setae on setigers 2 to around 5 and setigers 
27 to 31 markedly longer than setae on other setigers.

Last 5 setigers (setigers 28 to 32) decreasing rapidly to 
pygidium in size (Fig. 3b). Pygidium consisting of two lateral 
lobes, lacking triangular midventral anal plate; each lateral 
lobe fringed with 12 minute tapering cirri; midventral anal cir-
rus obscure (Fig. 3g).

Alometry and variation. All 35 specimens collected 
from four localities were pooled for the analysis of alometry 
and variation. Body height (BH$_1$ mm for setiger 5, BH$_2$ mm 
for setiger 15) was correlated with body length (BL mm) 
according to the regression formulae (Fig. 4): BH$_1$$=0.08$ 
BL$+0.6$ ($r^2=0.64$, $P<0.0001$), BH$_2$$=0.1$ BL$+0.2$ ($r^2=0.67$, 
$P<0.0001$). Maximum body length was 18 mm. Total num-
ber of setigers was 31 or 32 possibly, though its exact count
was difficult because the last 2–3 setigers were often immersed into an anterior one owing to various extent of constriction by fixation.

The number of dorsal and ventral conical cirri on setiger 10 varied between 6 and 11 (average±SD: 9.2±1.4) and between 2 and 4 (2.5±0.6), respectively. The number of dorsal conical cirri (D) was correlated with body length according to the regression formula (Fig. 5a): \( D = 0.18 \times BL + 7.2 \) \( (r^2=0.25, \ P=0.002) \). The number of ventral conical cirri on setiger 10 was almost constant at 2 or 3, and not significantly correlated with body length \( (r=0.18, \ P=0.3) \) (Fig. 5b).

The first setiger with ventral conical cirri was setiger 9 constantly, but the last setiger with those varied between setiger 17 and setiger 25. Therefore, number of setigers with ventral cirri (VC) varied between 9 and 17 \( (14.7±2.1) \), and it was correlated with body length according to the regression formula (Fig. 5c): \( VC = 0.25 \times BL + 12 \) \( (r^2=0.22, \ P=0.004) \).

All the specimens had 15 pairs of branchiae occurring on setigers 12 to 26 without any variation in their arrangement. The maximum number of branches of a branchia (B)
varied between 3 and 7 (5.3 ± 1.0), and it was correlated with body length according to the regression formula (Fig. 5d): B = 0.19 BL + 3.3 ($r^2 = 0.49$, $P < 0.0001$). The branchiae were well-stretched in some specimens (Figs. 2c and 3e), while relatively shrunk in other ones (Fig. 3f), probably owing to various extent of constriction by fixation.
The number of cirri on each lateral lobe of pygidium varies between 7 and 12, though exact count was difficult because of the minute size of the cirri. Midventral anal cirrus was often obscure, but visible as a tiny round protrusion between the two lateral lobes at least in some specimens (Fig. 3h).

Reproduction. Oocytes (70–80 µm in diameter) were contained in the body cavity of 5 females: 3 specimens (BL: 11–14 mm) collected from off Yumigahama Beach, Minami-izu in 25 May 2000 and 2 specimens (BL: 16–17 mm) collected from off Yura Beach, Miyazu in 25 September 2001.

Habitat. Subtidal sandy bottoms.

Distribution. Japanese coasts of the Pacific Ocean, the Sea of Japan and the East China Sea (Fig. 1).

Etymology. The specific name refers to Japan, the type locality of this species.

Remarks. *Euzonus japonicus* sp. nov. is morphologically most similar to *E. flabelliferus* (Ziegelmeier, 1955) known in northern Europe (the North Sea and the White Sea); they share a unique characteristic on setiger 10, i.e., a pair of lateral transverse rows of conical cirri, instead of a pair of lateral smooth ridges that is common to most *Euzo-
nus species. They are also unique in lacking a triangular midventral anal plate that is common to most Euzonus species.

*E. japonicus* sp. nov. differs from *E. flabelliferus* in some characteristics (Table 1): *E. japonicus* sp. nov. has palmatifid branchiae with 3–7 finger-shaped branches, while *E. flabelliferus* has trifid, bifid or unbranched branchiae (Ziegelmeier, 1955). In comparison using individuals with corresponding BL of 3.8–9.0 mm (values for *E. flabelliferus* are based on data shown in Ziegelmeier, 1955), maximum number of branches in a branchia was significantly larger in *E. japonicus* sp. nov. (range: 3–6, average ± SD: 4.5±0.9, n=14) than in *E. flabelliferus* (1–3, 2.2±0.6, n=22) (Mann-Whitney U-test: P<0.0001) (Fig. 5d). Number of dorsal conical cirri on setiger 10 was significantly larger in *E. japonicus* sp. nov. (6–10, 8.5±1.4, n=14) than in *E. flabelliferus* (5–7, 6.2±0.7, n=22) (P<0.0001) (Fig. 5a). Number of ventral conical cirri on setiger 10 was larger in *E. japonicus* sp. nov. (2–17, 13.6±2.6, n=14, from setiger 9 to setiger 17–25) than in *E. flabelliferus* (3–8, 5.6±1.4, n=22, from setiger 9 to setiger 11–16) (P<0.0001) (Fig. 5c).

All the specimens of *E. japonicus* sp. nov. were collected from subtidal zones up to 15 m in depth. Similarly, *E. flabelliferus* has been reported from subtidal zones in the North Sea and the White Sea (Ziegelmeier, 1955; Tzetlin, 1978; Hartmann-Schröder, 1996). The subtidal habitats for *E. japonicus* sp. nov. and *E. flabelliferus* are in contrast with the intertidal habitats mainly restricted within upper to midtidal zones for most *Euzonus* species (Okuda, 1934; McConnaughey and Fox, 1949; Dales, 1952; Probert, 1976; Kemp, 1988; Buzhinskaja, 1991; Jaramillo et al., 1993; Jaramillo, 1994; Hartmann-Schröder and Parker, 1995; Souza and Gianuca, 1995; our unpublished data).

We re-examined ten specimens, which were collected from off Yura Beach, Miyazu in 20 August 1973 and reported as *E. ezoensis* by Yokoyama and Hayashi (1980), and judged them as *E. japonicus* sp. nov. Horikoshi and Tamaki (1978) and Sakurai et al. (2001) also reported the occurrence of "E. ezoensis" from subtidal zones up to 19 m in depth in northern Japan. Their specimens also may be *E. japonicus* sp. nov. though we have not examined them.

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<table>
<thead>
<tr>
<th>Species (Locality)</th>
<th><em>E. japonicus</em> sp. nov. (Japan)</th>
<th><em>E. flabelliferus</em> (North Sea)</th>
<th><em>E. flabelliferus</em> (White Sea)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum body length (mm)</td>
<td>18</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Total number of setigers</td>
<td>31–32</td>
<td>31 or 32*</td>
<td>?</td>
</tr>
<tr>
<td>No. of dorsal conical cirri on setiger 10</td>
<td>6–11</td>
<td>5–7</td>
<td>?</td>
</tr>
<tr>
<td>No. of ventral conical cirri on setiger 10</td>
<td>2–4</td>
<td>1</td>
<td>?</td>
</tr>
<tr>
<td>First / last setiger with ventral cirri (No. of setigers with ventral cirri)</td>
<td>9 / 17–25 (9–17)</td>
<td>9 / 11–16 (3–8)</td>
<td>?</td>
</tr>
<tr>
<td>First / last branchiate setiger (No. of branchiate setigers)</td>
<td>12 / 26 (15)</td>
<td>12 / 25 (14)</td>
<td>12 / 24 (13)</td>
</tr>
<tr>
<td>Maximum number of branches of a branchia</td>
<td>3–7</td>
<td>1–3</td>
<td>2</td>
</tr>
<tr>
<td>No. and form of cirri on each lateral lobe of pygidium</td>
<td>7–12 tapering</td>
<td>7 round</td>
<td>?</td>
</tr>
<tr>
<td>Form of midventral anal cirrus</td>
<td>round, often obscure</td>
<td>round</td>
<td>?</td>
</tr>
</tbody>
</table>

Table 1. Comparison of morphological characteristics in two subtidal *Euzonus* species
New species of *Euzonus* from Japan


Imajima M, Hartman O (1964) Polychaetous annelids of Japan. Allan Hancock Found Occas Pap 26: 1–452


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