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A New Record of the Genus *Pista* (Polychaeta: Terebellidae) from Korea: The Validity and Redescription of *Pista shizugawaensis*

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ABSTRACT

A terebellid polychaete identified as *Pista shizugawaensis* Nishi and Tanaka, 2006, whose species validity has been doubted, is newly reported from the southwest coast of Korea. Korean materials of the present study have several characteristics that agree well with the original description of *P. shizugawaensis* as follows: two pairs of branchiae on the 2nd and 3rd segments have tufts composed of many dichotomously branched filaments; the nephridial papillae are present on the 6th and 7th segments; the uncini on the anterior and middle thoracic segments possess only long-handled shafts while those on the posterior ones have additional short-handled shafts or lacking shafts; the notosetae are broadly or narrowly winged capillary. The authors examined the taxonomic value of the presence of lateral lobes on the 5th and 6th segments, which has been known as a key characteristic feature of *P. shizugawaensis* in the classification of *Pista* species. In the present study, several characteristics such as the shape of notosetae, uncinial shafts in the thoracic segments, and the presence of thin narrow lateral lobes on the 4th segment are suggested as the specific characteristics that help to distinguish *P. shizugawaensis* from its congeners. A key to *Pista* species from Korean waters is also provided.

Keywords: *Pista shizugawaensis*, Polychaeta, Terebellidae, taxonomy, Korea

INTRODUCTION

The family Terebellidae Johnston, 1846 is an easily recognizable group in shallow waters or intertidals due to the extensible tentacles used for feeding and brightly colored brachial plumes that extend from their anterior region (Fauchald and Jumars, 1979). Among them, genus *Pista* Malmgren, 1866 is widely distributed throughout the world and has a large number in species abundance (Leontovich and Jirkov, 2011; Nogueira et al., 2011). The taxonomy of this genus has been confused because of the original description of *Pista cristata* (Müller, 1776), type species of the genus, which did not provide adequate information for defining the species and the genus (Londoño-Mesa, 2012). The major characters for distinguishing the species of *Pista* are presently known as the morphologies of lateral lobes on anterior segments, uncini, nephridial papillae, branchiae, and notopodia (Dos Santos et al., 2010; Nogueira et al., 2011).

Presently, about 62 species and two subspecies of the genus *Pista* are known worldwide (Londoño-Mesa, 2012). Among them, two species, *P. cristata* (Müller, 1776) and *P. fasciata* (Grube, 1870), have been recorded from Korean waters (Paik, 1982, 1989; Kim and Paik, 1993). However, the previous reports of *Pista* species from Korean waters were too brief and provided limited information on the major characters of *Pista*. Hence, a detailed revision about *Pista* species from Korean waters is necessary.

In the present study, the authors deal with a newly recorded *Pista* species, *P. shizugawaensis* Nishi and Tanaka, 2006, from Korean waters. The taxonomic status of this species has been confused because of the controversy about the presence of reduced lateral lobes on the 5th and 6th segments (Leontovich and Jirkov, 2011), which was described as a key characteristic feature of *P. shizugawaensis* in the original

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description (Nishi and Tanaka, 2006). Although Nishi and Tanaka (2006) and Leontovich and Jirkov (2011) used this feature for a key character in the *Pista* classification, we could find that it is shared by several *Pista* species from investigating previous literatures (Marenzellar, 1884; Imajima and Hartman, 1964; Hutchings and Glasby, 1988; Londoño-Mesa, 2009; Dos Santos et al., 2010; Nogueira et al., 2011).

The purpose of this study is to determine the taxonomic value of the presence of lateral lobes on the 5th and 6th segments in the classification of *Pista* species. We also aim to redescribe *P. shizugawaensis* with detailed description and illustrations. A key to *Pista* species from Korean waters is provided in this paper.

MATERIALS AND METHODS

Samples were collected from a mudflat in the southwestern coast of Korea. The specimens were sorted by using sieves with a pore size of 0.5 mm, fixed initially with 5% formaldehyde-seawater solution, and transferred to 85% ethyl alcohol after sorting in the laboratory. The characteristics of the whole body were observed and both notosetae and uncini were dissected in a petri dish by using dissection forceps or surgical knives and needles under the stereomicroscope (SMZ1500; Olympus, Tokyo, Japan). They were mounted on temporary slides using glycerol or permanent slides using polyvinyl lactophenol solution. Drawings were made by the stereomicroscope, and the light microscope (LABOPHOT-2; Nikon, Tokyo, Japan) with the aid of drawing tubes.

SYSTEMATIC ACCOUNTS

Class Polychaeta Grube, 1850
Order Terebellida (Rouse and Fauchald, 1997)
Family Terebellidae Johnston, 1846
Subfamily Terebellinae Malmgren, 1866

Genus *Pista* Malmgren, 1866

Pista Malmgren, 1866: 382; Fauchald, 1977: 132; Hutchings, 1977: 19; Hutchings and Glasby, 1988: 38; Dos Santos et al., 2010: 32; Nogueira et al., 2011: 3.

Diagnosis. Buccal tentacles numerous. Lateral lobes present on anterior thoracic segment. Branchiae composed of 1 to 3 pairs. Notopodia beginning from 4th segment, composed of 17 pairs. Notosetae broadly or narrowly winged capillary, or simple capillary with small denticles on surface. Neuropodia beginning from 5th segment. Uncini initially arranged in single rows, arranged in double rows on posterior thoracic segments, and arranged in single rows on abdominal segments; thoracic uncini with long-handled shafts.

Type species: *Pista cristata* (Müller, 1776).

Remarks. Nogueira et al. (2011) pointed out that this genus possesses only broadly winged capillary notosetae. However, our materials of this genus from Korean waters show broadly or narrowly winged capillary shape of notosetae. *Pista* species described by Leontovich and Jirkov (2011) also has simple capillary notosetae bearing small denticles on the surface.

Key to species of the genus *Pista* from Korea

1. Posterior thoracic segments with uncini bearing long handled shafts and additional short handled shafts or lacking shafts ····· *P. shizugawaensis* Nishi and Tanaka, 2006
- Posterior thoracic segments with uncini bearing long handled shafts only ····· 2
2. Lateral lobes on peristomium well developed; branchiae arborescent, with short stalk ····· *P. faciata* (Grube, 1870)
- Lateral lobes on peristomium very short; branchiae with filaments arranged in a spiral at distal tips and long stalk ····· *P. cristata* (Müller, 1776)

[1]*_Pista shizugawaensis_ Nishi and Tanaka, 2006

Pista shizugawaensis Nishi and Tanaka, 2006: 141, figs. 2–4.

Material examined. 2 specimens collected at Daecheon-ri, Aphae-eup, Shinan-gun, Jeollanam-do, Korea (34°51′56″N, 126°21′53″E), 19 Dec 2011, Choi HK.

Description. Body about 10.0 cm long; thoracic width about 0.4 cm at 6th setiger; abdominal width about 0.1 cm. Eyespots absent. Buccal tentacles numerous, arose from thickened glandular margin. Prostomium compact with anteriorly projecting tongue, with convoluted glandular margins. Peristomium thickened, with 2 large lateral lobes; lateral lobes distally rounded, extended anteriorly and ventrally, fused mid-ventrally (Fig. 1A–C).

Branchiae 2 pairs, composed of large ones on 2nd segment and small ones on 3rd segment; each branchia with stout, long annulated stalk and plume-shaped head bearing tufts composed of many dichotomously branched filaments; filaments arranged in irregular spiral (Fig. 1A).

Lateral lobes attached from 2nd to 6th segments; 2nd segment with flattened ventro-lateral lobes, fused mid-ventrally, and formed single small lobe; 3rd segment with wide and rounded semi-rectangular lateral lobes, more lateral in posi-

Korean name: [1]*넓은총채유령갯지렁이 (신칭)

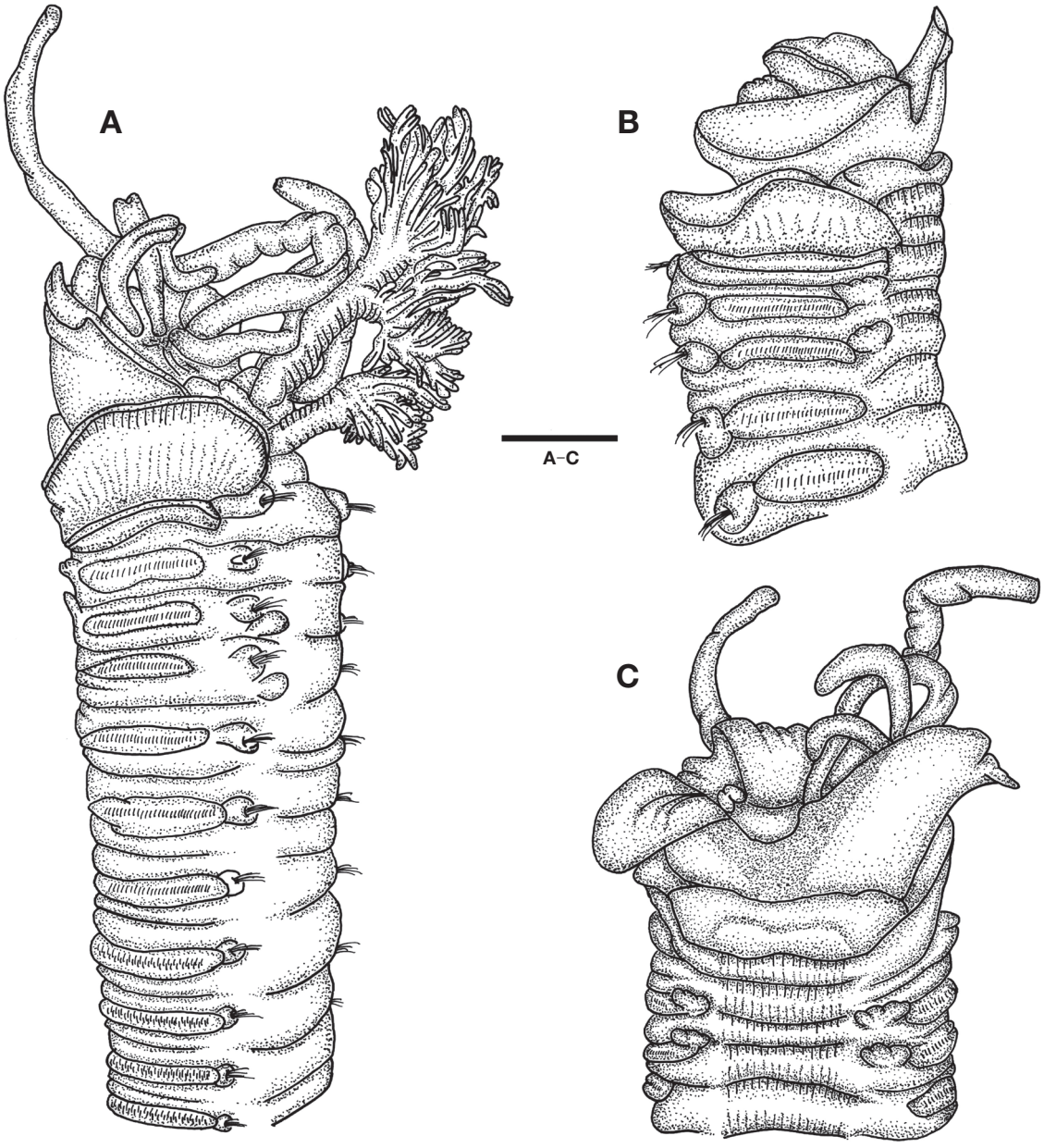

Fig. 1. *Pista shizugawaensis* Nishi and Tanaka, 2006. A, Dorso-lateral view (branchiae on the opposite lateral side are omitted); B, Ventro-lateral view (tentacles are omitted); C, Ventral view. Scale bar: A–C = 1.0 mm.

tion than those on 2nd segment, and lobes divided into dorsal and ventral parts but connected across ventral part by very narrow ridge; 4th segment with thin narrow lateral lobes, reached to ventral pad, completely divided into dorsal and ventral parts; 5th and 6th segments with reduced lateral lobes composed of 2 pairs, located more ventrally than those on 2nd to 4th segments; lateral lobes positioned between neuropodial uncini and ventral pad; lobes on 6th segment slightly smaller than those on 5th segment (Fig. 1A–C).

Ventral pads conspicuous on thoracic setigers, eventually disappeared on abdominal setgers (Fig. 1B, C).

Nephridial papillae very small, present on 6th and 7th segments, inserted below notopodia (Fig. 1A).

Notopodia globular shaped, consisted of 17 pairs from 4th segment (Fig. 1A, B); notosetae broadly or narrowly winged capillary, each with different length (Fig. 2A, B).

Neuropodia beginning from 5th segment (2nd setiger) and continued to pygidium; thoracic neuropodia long, flattened

rectangular shaped, and abdominal neuropodia reduced (Fig. 1A).

Uncini (neurosetae) well chitinised, arranged in single rows from 5th to 10th thoracic segments (2nd to 7th setigers) and subsequently arranged in double rows until last thoracic segment (17th setiger), and then arranged in single rows on abdominal segments (Fig. 1A); thoracic uncini arranged in single rows possessing long handled shafts and hook-shaped crested head, with dental formula MF (main fang): 4−5, 5−6, 6, α (difficult to count) (Fig. 2C, D); thoracic uncini arranged in double rows bearing similar crested head to those in single rows, with long-handled shafts from 11th to 20th segments (8th to 17th setigers) and with additional short-handled shafts or lacking shafts from 18th to 20th segments (15th to 17th setigers) (Fig. 2E, F); abdominal uncini arranged in single rows without shaft, with crested head smaller than thoracic ones (Fig. 2G).

Remarks. *Pista shizugawaensis* was first described from Shizugawa Bay in Japan by Nishi and Tanaka (2006). The original description of this species suggested the following several distinguishable characteristics: two pairs of reduced lateral lobes are located on the 5th and 6th segments; two pairs of branchiae on the 2nd and 3rd segments have tufts composed of many dichotomously branched filaments; the nephridial papillae are present on the 6th and 7th segments; the uncini on the thoracic segments possess long-handled shafts and additional short-handled shafts or lacking shafts appearing in the uncini on the posterior ones; the notosetae are broadly or narrowly winged capillary (Nishi and Tanaka, 2006). In this respect, our Korean materials of *P. shizugawaensis* generally agree well with the original description of Japanese materials (Nishi and Tanaka, 2006), however, there are some minor differences: the lateral lobes on the 3rd segment are sub-rectangular shaped in Korean materials, while those in Japanese materials are semi-circular shaped; the dental formula of Korean materials is MF: 4−5, 5−6, 6, α in the uncini arranged in single rows, but that of Japanese materials is MF: 5−6, 5−6, 6, 7, α, α (Nishi and Tanaka, 2006).

Pista shizugawaensis is closely related to *P. cristata* and *P. fasciata* reported from Korean waters in which the two paired branchiae are located on the 2nd and 3rd segments, the thoracic segments consist of 17 setigers, the uncini are arranged in double rows from the 11th to 20th segments, the long-handled shafts are present on the uncini of thoracic segments, and the nephridial papillae are found from 6th and 7th segments. However, *P. shizugawaensis* of the present study shows the following different characteristics compared to those of these two species: *P. shizugawaensis* has reduced lateral lobes on the 5th and 6th segments, but both *P. cristata* and *P. fasciata* have not; *P. shizugawaensis* possesses branchiae bearing a long stalk and many dichotomously branched filaments, while branchiae of *P. cristata* have a long stalk and the filaments arranged in a spiral at the distal tip, and those of *P. fasciata* are arborescent and bear a short stalk; *P. shizugawaensis* has notosetae composed of broadly or narrowly winged capillary setae, but both *P. cristata* and *P. fasciata* have those of broadly winged capillary only; *P. shizugawaensis* has short-handled shafts or lacking shafts that appear additionally in the uncini on the posterior thoracic segments, while *P. cristata* and *P. fasciata* do not possess them. On the other hand, *P. cristata* has very short lateral lobes on the prostomium and well developed lateral lobes from the 2nd to 4th segments, while *P. fasciata* possesses well developed lateral lobes on the prostomium and poorly developed lateral lobes from the 2nd to 4th segments (Müller, 1776; Grube, 1870; Marenzellar 1884; Imajima and Hartman, 1964; Day, 1967; Paik, 1982; Kim and Paik, 1993; Nishi and Tanaka, 2006; Nogueira et al., 2011; Sui, 2013) (Table 1).

Discussion. Banse (1980) pointed out that *P. brevibranchiata* Moore, 1923 was characterized by the presence of lateral lobes on the 5th and 6th segments. At this point, Leontovich and Jirkov (2011) considered that *P. shizugawaensis* was a synonym of *P. brevibranchiata* based on the opinion given by Banse (1980). However, *P. shizugawaensis* differs from *P. brevibranchiata* referred by Leontovich and Jirkov (2011) in terms of the detailed shape of notosetae. *P. shizugawaensis* has broadly or narrowly winged capillary notosetae, while *P. brevibranchiata* shows capillary notosetae bearing only small denticles on the surface. Also, *P. shizugawaensis* has short-handled shafts or lacking shafts that appear additionally in the uncini on the posterior thoracic segments, but *P. brevibranchiata* has only long handled shafts (Leontovich and Jirkov, 2011). The shape of uncini on the thoracic segments is known to be an important character in *Pista* taxonomy (Dos Santos et al., 2010; Nogueira et al., 2011). Therefore, we consider that *P. shizugawaensis* is a completely distinct species from *P. brevibranchiata*, and the synonym of *P. brevibranchiata* as referred by Leontovich and Jirkov (2011) needs to be emended.

Pista fasciata sensu Marenzellar, 1884, which was described by Imajima and Hartman (1964) from Japanese waters, was also regarded as a synonym of *P. brevibranchiata* by Leontovich and Jirkov (2011) because Japanese specimens studied by Imajima and Hartman (1964) possess lateral lobes on the 5th and 6th segments as pointed out by Banse (1980). The authors could also find out the presence of lateral lobes on the 5th and 6th segments in the report of *P. fasciata* described by Marenzellar (1884). However, *P. fasciata* sensu Marenzellar, 1884 differs from *P. brevibranchiata* described by Leontovich and Jirkov (2011) and *P. shizugawaensis* of the present study by the presence of the notosetae with large teeth arranged in one side of the tip (Marenzellar, 1884).

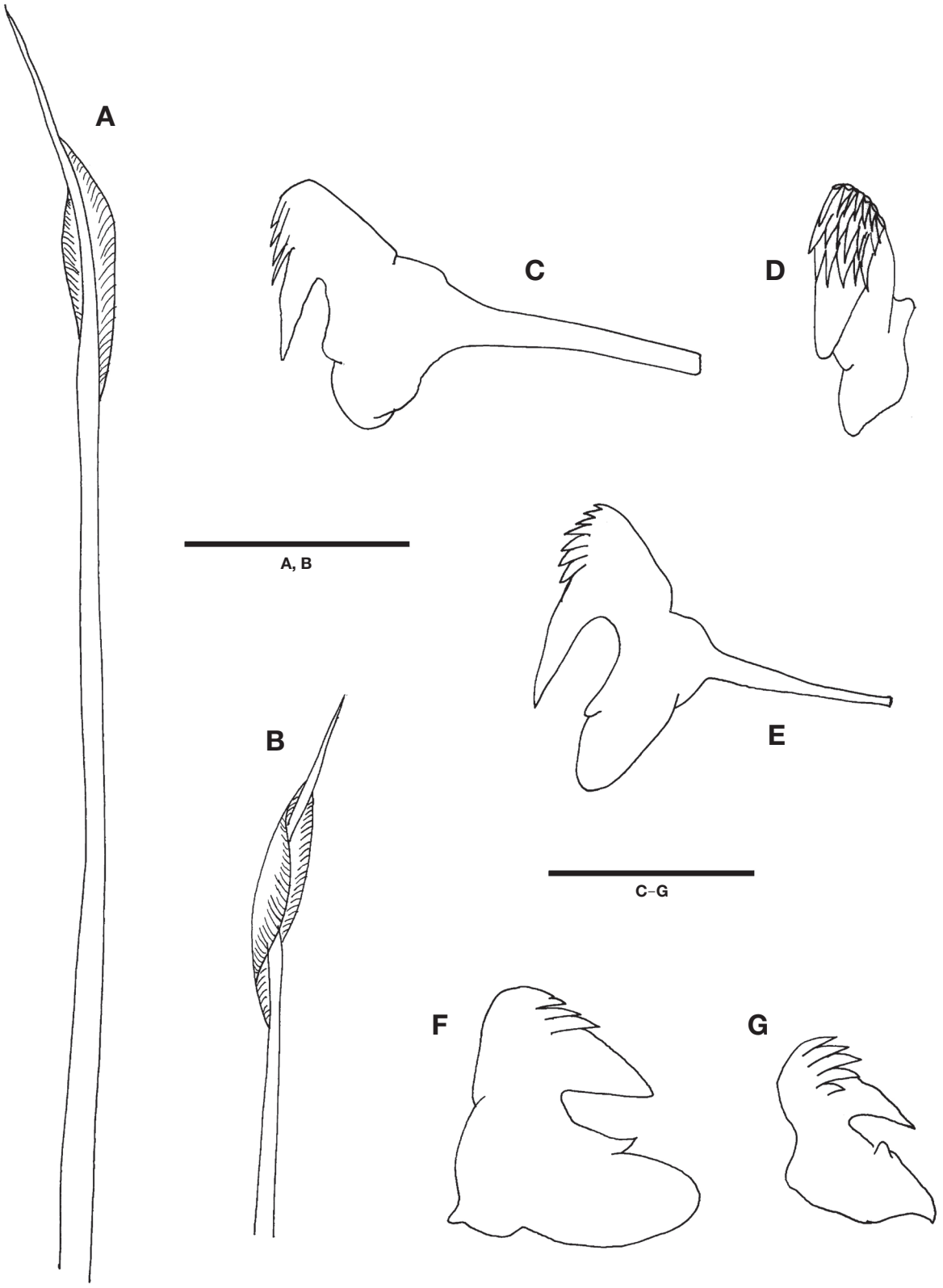

Fig. 2. *Pista shizugawaensis* Nishi and Tanaka, 2006. A, B, Notosetae from 7th segment, with long (A) and short lengths (B); C–F, Uncini (neurosetae) of thoracic segments, arranged in single row (C) and with crested head (D) on 7th segment, arranged in double rows on 11th segment (E) and 18th segment (F); G, Abdominal uncini. Scale bars: A, B = 0.2 mm, C–G = 0.05 mm.

Table 1. Comparison of morphological characteristics among *Pista* species from Korean waters

Characters	*P. cristata* (Müller, 1776)	*P. fasciata* (Grube, 1870)	*P. shizugawaensis* Nishi and Tanaka, 2006
Lateral lobes on peristomium	Very short	Well developed	Well developed
Lateral lobes on 2nd segments	Well developed	Absent	Well developed
Lateral lobes on 3rd segments	Wide and sub-rectangular shape	Reduced	Wide and sub-rectangular shape
Lateral lobes on 4th segments	Thin narrow flaps	Absent	Thin narrow flaps
Lateral lobes on 5th–6th segments	Absent	Absent	Present
Number of branchiae	2 pairs	2 pairs	2 pairs
Shape of branchiae	With long stalk and filaments arranged in a spiral at distal tip	With short stalk and arborescent	With long stalk and many dichotomously branched filaments
Number of thoracic setigers	17	17	17
Shape of notosetae	Bordly winged capillary	Bordly winged capillary	Broad bladed and narrow winged capillary
Thoracic uncini arranged in single rows	From 5th to 10th segments	From 5th to 10th segments	From 5th to 10th segments
Thoracic uncini arranged in double rows	From 11th to 20th segments	From 11th to 20th segments	From 11th to 20th segments
Thoracic uncini with long handled shafts	5th–20th segments	5th–20th segments	5th–20th segments
Thoracic uncini with short handled or lacking shafts	Absent	Absent	Patially appeared in posterior thoracic segments

Except for the species mentioned above, we found that other *Pista* species also show a similar feature. Six *Pista* species reported from the Caribbean Sea and the Atlantic coast of South America have lateral lobes on the 5th and 6th segments (Londoño-Mesa, 2009; Dos Santos et al., 2010; Nogueira et al., 2011): *P. alonsae* Santos et al., 2010, *P. cetrata* (Ehlers, 1887), *P. corrientis* McIntosh, 1885, *P. nonatoi* Nogueira et al., 2011, and *P. palmata* (Verrill, 1873). In spite of being poorly described, *Pista sinusa* Hutchings and Glasby, 1988 reported from Australia also shows a similar feature based on the figure (Hutchings and Glasby, 1988). However, *P. shizugawaensis* differs from these species by the presence of uncini bearing short-handled shafts or lacking shafts in the posterior thoracic segments (Hutchings and Glasby, 1988; Nishi and Tanaka, 2006; Dos Santos et al., 2010; Nogueira et al., 2011). Among them, only *P. cetrata* has uncini bearing short-handled shafts or lacking shafts, but *P. shizugawaensis* can be distinguished from *P. cetrata* by the presence of thin and narrow lateral lobes on the 4th segment because *P. cetrata* bears triangular and large lateral lobes (Londoño-Mesa, 2009).

Conclusively, the presence of reduced lateral lobes on the 5th and 6th segments, which was described as a key characteristic feature in the original description by Nishi and Tanaka (2006), is not a valid characteristic of *P. shizugawaensis* because it is shared by several *Pista* species. We suggest that the useful characteristics of *P. shizugawaensis* that help to distinguish it from its congeners are the morphologies of notosetae, uncini, and other lateral lobes besides those on the 5th and 6th segments.

Distribution. Intertidal soft bottoms of Korea and Japan.

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