

Two New Species of *Composetia* (Annelida: Nereididae) from Small Estuaries in the Ryukyu Islands, Southern Japan, with a List of All Species Currently Belonging to *Composetia*

Masanori Sato

Graduate School of Science and Engineering, Kagoshima University, Kagoshima 890-0065, Japan
E-mail: sato@sci.kagoshima-u.ac.jp

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Two new species *Composetia kumensis* and *C. tokashikiensis* (Nereididae) are described based on specimens collected from subtropical small estuaries in the Kume-jima and Tokashiki-jima islands in the middle Ryukyu Islands, southern Japan, respectively. Both species have the following diagnostic characteristics of *Composetia* Hartmann-Schröder, 1985: (1) having conical paragnaths in the maxillary ring of the proboscis and lacking paragnaths or papillae in the oral ring, (2) prostomium with entire anterior margin, (3) the absence of falcigers among notochaetae, and (4) the absence of simple chaetae among upper neurochaetae. These new species share the following diagnostic characters: (1) presence of notoacacula on chaetigers 1 and 2, (2) absence of notopodial prechaetal lobe throughout body, (3) presence of neuropodial postchaetal lobe only in anterior body, (4) neuropodial falcigers all heterogomph, and (5) oral ring greatly enlarged in full-everted proboscis. However, *C. tokashikiensis* sp. nov. is distinguishable from *C. kumensis* sp. nov. by the presence of heterogomph spinigers among the upper neurochaetae around chaetiger 5. A list of all of 34 species currently belonging to *Composetia* and a key to Japanese species of *Composetia* are also provided.

Key Words: East Asia, non-marine species, notoacacula, polychaete, subtropical estuaries, taxonomy.

Introduction

Most polychaetes are marine species and only a limited number of species known as non-marine species occur in freshwater or brackish-water habitats (about 200 species, about 2% of the estimated 9000–12000 species worldwide); the family Nereididae includes the most abundant non-marine species (61 species) (Glasby *et al.* 2009). However, taxonomical surveys of non-marine species seem to be insufficient in tropical and subtropical Asia, which is an area with the greatest diversity of coastal marine species in the world (*e.g.*, Tittensor *et al.* 2010).

During a survey on nereidid fauna in subtropical small estuaries surrounded by coral reefs in the middle Ryukyu Islands in southern Japan, two morphologically similar undescribed species of *Composetia* Hartmann-Schröder, 1985 [as *Ceratonereis* (*Composetia*) in Sato (2012); see Sato and Sakaguchi 2016; Sato 2017] were found from a unique habitat exposing to usually fresh water, but sometimes full-strength sea water. Here, the two species are described as new species of *Composetia*. Additionally, a key to species of *Composetia* recorded from Japan is also provided based on this study and previous references.

Materials and Methods

Specimens were collected from two small estuaries on

islands of the middle of Ryukyu Islands, southern Japan: an estuary consisting in a small creek in the upper intertidal zone of the uplifted coral reef on Kume-jima island in 1999–2013, and the another one in the Tokashiki-gawa river on Tokashiki-jima island in 1991. Specimens were found in sediment samples, which were obtained by shoveling from intertidal sandy bottoms. The specimens were fixed in 10% formalin or in 80 or 99% ethanol, and transferred to 80 or 99% ethanol for preservation. Photographs of live specimens were taken with a digital camera (Konica-Minolta Alpha-7). Water temperature and salinity were measured with a SCT meter (Model 30, Yellow Springs Instrument, Co.).

For the preserved specimens, body length (BL) from the anterior end of the prostomium to the posterior end of the pygidium excluding anal cirri, and anterior maximum body width (BW) excluding parapodia were measured. Photographs of the specimens were taken with a digital camera (Nikon COOLPIX) on a stereoscopic microscope. Drawings were prepared with a camera lucida.

Terminology of paragnath groups on proboscis, and that of parapodial and chaetal morphology are according to Bakken and Wilson (2005).

Type specimens are deposited in the polychaete collection of the National Museum of Nature and Science, Tsukuba, Japan (NSMT).

Taxonomic Account

Family **Nereididae** de Blainville, 1818

Genus **Composetia** Hartmann-Schröder, 1985

Ceratonereis (*Composetia*) Hartmann-Schröder, 1985: 49.

Composetia: Khlebovich 1996: 122; Bakken and Wilson 2005: 520–521; Bakken *et al.* 2018: 25.

Diagnosis. Prostomium with entire anterior margin, one pair of antennae, one pair of palps, and two pairs of eyes. Eversible proboscis with conical paragnaths only on maxillary ring, without any paragnath and papilla (or soft cushion) on oral ring. Four pairs of tentacular cirri. Parapodia of first two chaetigers sub-biramous, all following parapodia biramous. Sub-biramous parapodia with or without notoacacula. Notopodial prechaetal lobe present or absent. Notochaetae all homogomph spinigers. Neurochaetae all compound with homogomph, sesquigomph or heterogomph articulations, simple chaetae absent.

Gender. Feminine.

Type Species. *Nereis costae* Grube, 1840, fixed by original designation.

Remarks. Formerly, the nereidids that have the proboscis with conical paragnaths on the maxillary ring only were all identified as the genus *Ceratonereis* Kinberg, 1865 (Fauchald 1977). Later, Hartmann-Schröder (1985) divided this genus into three subgenera: *Ceratonereis* (*Ceratonereis*) characterized by the prostomium with an indented anterior margin, the presence of soft cushions or papillae on the areas VI in the oral ring, and all the chaetae compound with both hemigomph (sesquigomph) and heterogomph articulations; *Ceratonereis* (*Composetia*) characterized by the prostomium with an entire anterior margin, the absence of soft cushions or papillae on the area VI, and all the chaetae compound with both homogomph and heterogomph articulations; and *Ceratonereis* (*Simplisetia*) Hartmann-Schröder, 1985 characterized by the prostomium with an entire anterior margin, the absence of soft cushions or papillae on the area VI, and the presence of simple chaetae in middle and posterior neuropodia in addition to both compound homogomph and heterogomph chaetae. Khlebovich (1996) elevated each of the three subgenera to the rank of genus, and he noticed that *Ceratonereis* is also distinguishable from *Simplisetia* and *Composetia* in the presence of notopodial sesquigomph falcigers in contrast to the absence of the same in the latter two genera, highlighting that Hartmann-Schröder (1985) incorrectly described that all of the three subgenera have such falcigers.

After Khlebovich (1996), 29 of 30 species categorized as *Ceratonereis* (*Composetia*) by Hartmann-Schröder (1985) and Hartmann-Schröder and Rosenfeldt (1988) have been assigned to the genus *Composetia*, except for *Ceratonereis* (*Composetia*) *burmensis* (Monro, 1937) that was regarded as a junior synonym of *Neanthes glandicinca* Southern, 1912 by Lee and Glasby (2015). Additionally, Pamungkas and Glasby (2015) transferred *Nereis* (*Ceratonereis*) *marmorata*

Horst, 1924, which was described based on only epitokous specimens and classified as “insufficiently known species” by Hartmann-Schröder (1985), to *Composetia*. Thereafter, one more species of *Composetia*, *C. bundaiensis* Hsueh, 2018, was described (Hsueh 2018), summarizing a total of 31 species have been assigned to *Composetia* up to date (Table 1).

However, the following eight species should be reexamined in future, because it seems uncertain whether they belong to *Composetia* or not: three species, *C. beringiana* (Levenstein, 1961), *C. gorbunovi* (Uschakov, 1950) and *C. paucidentata* (Moore, 1903), have several paragnaths on oral ring according to their original descriptions, deviating from the generic diagnosis; three species, *C. dunckeri* (Augener, 1925), *C. monronis* (Westheide, 1977) and *C. tunicaetae* (Hartman, 1936), have notopodial homogomph falcigers in posterior chaetigers, deviating from the generic diagnosis; two species, *C. dubia* (Rullier, 1972) and *C. pietschmanni* (Holly, 1935) were described based on only epitokous specimens, without any more additional description of atokes.

Though *C. marmorata* also lacks information of atokous morphology in both the original description and the redescription by Pamungkas and Glasby (2015), its assignment to *Composetia* is supported by the description of atokous specimens from China by Wu *et al.* (1985; as *Ceratonereis marmorata*), who described that all chaetae (homogomph spinigers and hererogomph falcigers) compound, lacking simple chaeta, and notopodial falcigers absent.

Ceratonereis tripartita Horst, 1918 was also originally described based on only epitokous specimens (type locality: Malay Archipelago) and classified as “insufficiently known species” by Hartmann-Schröder (1985). However, Fauvel (1932, 1953) described that an atokous specimen of this species collected from the Andaman Islands had only compound chaetae (homogomph and hererogomph spinigers, and hererogomph falcigers) and lacked neuropodial simple chaetae and notopodial falcigers, well supporting that his specimen belongs to the genus *Composetia*. Therefore, this species is newly assigned to *Composetia* in the present study, though it is not enough evidenced whether the atokous specimen of Fauvel (1932, 1953) really belongs to the same species as the epitokous type specimens.

Furthermore, two new species are described as members of this genus in the present study (see below). Thus, a total of 34 species currently belong to *Composetia* (Table 1).

Composetia was redefined by Bakken and Wilson (2005), who provided the generic diagnosis based on the descriptions of the non-type species, *C. irritabilis* (Webster, 1879) and *C. scotiae* (Berkeley and Berkeley, 1956), owing to their situation that the type material of the type species *C. costae* could not be located. In fact, however, at least 11 syntypes of *C. costae* have been safely preserved in the Museum of Natural History in Berlin (Hertwich 1993; recent unpublished observation by the present author). *Composetia* seems not to be a monophyletic group, but to include some morphologically distinct groups, as suggested by Bakken and Wilson (2005). Revision of *Composetia* with the exact generic definition based on the redescription of the type material of *C. costae* is needed.

Table 1. A list of all of 34 species currently belonging to the genus *Composetia* Hartmann-Schröder, 1985.

Species and subjective synonyms	Original combination	Type locality
31 species previously assigned to <i>Composetia</i>		
<i>C. anoculata</i> (Amoureux, 1982)	<i>Ceratonereis anoculata</i>	between Brittany and Ireland, Atlantic Ocean
<i>C. antarctica</i> (Hartmann-Schröder and Rosenfeldt, 1988)	<i>Ceratonereis (Composetia) antarctica</i>	South Shetland Islands, off Antarctic Peninsula
<i>C. articulata</i> (Ehlers, 1887)	<i>Nereis articulata</i>	off Sand Key, Florida, Atlantic Ocean
<i>C. beringiana</i> (Levenstein, 1961) ¹	<i>Nereis (Ceratonereis) beringianus</i>	western parts of the Bering Sea
<i>C. brasiliensis</i> (McIntosh, 1885)	<i>Nereis (Ceratonereis) brasiliensis</i>	Brazil, Atlantic Ocean
<i>C. bundaiensis</i> Hsueh, 2018	<i>Composetia bundaiensis</i>	Taiwan, Pacific Ocean
<i>C. coracina</i> (Grube, 1878)	<i>Nereis (Ceratonereis) coracina</i>	Singapore and Philippines, Pacific Ocean
<i>C. costae</i> (Grube, 1840)	<i>Nereis costae</i>	Mediterranean Sea
<i>Ceratonereis brunnea</i> Langerhans, 1884 ²		Madeira, Atlantic Ocean
<i>Ceratonereis punctata</i> Saint-Joseph, 1906 ²		Cannes, France, Atlantic Ocean
<i>Nereis (Ceratonereis) guttata</i> Claparède, 1868 ³		Gulf of Naples, Mediterranean Sea
<i>Nereis (Ceratonereis) lapinigenis</i> Grube, 1878 ³		Philippines, Pacific Ocean
<i>Nereis rubroannulata</i> Claparède in Grube, 1870 ⁴		Gulf of Naples, Mediterranean Sea
<i>C. dualaensis</i> (Augener, 1918)	<i>Nereis (Ceratonereis) dualaensis</i>	Cameroon, Africa, Atlantic Ocean
<i>C. dubia</i> (Rullier, 1972) ⁵	<i>Nereis (Ceratonereis) dubia</i>	Loyalty Islands, New Caledonia, Pacific Ocean
<i>C. dunckeri</i> (Augener, 1925) ⁶	<i>Nereis (Ceratonereis) dunckeri</i>	The Bismarck Archipelago, Pacific Ocean
<i>C. fakaravae</i> (Chamberlin, 1919)	<i>Ceratonereis fakaravae</i>	Tuamotu Islands, Pacific Ocean
<i>C. flagellipes</i> (Fauvel, 1932)	<i>Nereis (Ceratonereis) flagellipes</i>	Ganjam Coast, India
<i>C. gorbunovi</i> (Uschakov, 1950) ¹	<i>Nereis (Ceratonereis) gorbunovi</i>	Okhotsk Sea
<i>C. hircinicola</i> (Eisig, 1870)	<i>Nereis hircinicola</i>	Mediterranean Sea
<i>C. hyalognatha</i> (Ehlers, 1920)	<i>Nereis (Ceratonereis) hyalognatha</i>	Amboina in Indonesia
<i>C. irritabilis</i> (Webster, 1879)	<i>Nereis irritabilis</i>	Virginia, Atlantic Ocean
<i>C. keiskama</i> (Day, 1953)	<i>Ceratonereis keiskama</i>	Keiskama Estuary, South Africa
<i>C. marmorata</i> (Horst, 1924) ⁷	<i>Nereis (Ceratonereis) marmorata</i>	Indonesia, Pacific Ocean
<i>C. microcephala</i> (Grube, 1878)	<i>Nereis (Ceratonereis) microcephala</i>	Philippines, Pacific Ocean
<i>C. monronis</i> (Westheide, 1977) ⁶	<i>Ceratonereis monronis</i>	Galapagos, Pacific Ocean
<i>C. moorei</i> (Imajima, 1972)	<i>Ceratonereis moorei</i>	Central Japan, Pacific Ocean
<i>C. paucidentata</i> (Moore, 1903) ¹	<i>Nereis paucidentata</i>	north of the Aleutian Islands, Bering Sea
<i>C. pietschmanni</i> (Holly, 1935) ⁵	<i>Nereis (Ceratonereis) pietschmanni</i>	Hawaii, Pacific Ocean
<i>C. rolasiensis</i> (Augener, 1918)	<i>Nereis rolasiensis</i>	West Africa, Atlantic Ocean
<i>C. scotiae</i> (Berkeley and Berkeley, 1956)	<i>Nereis (Ceratonereis) scotiae</i>	Nova Scotia, eastern Canada, Atlantic Ocean
<i>C. tunicatae</i> (Hartman, 1936) ⁶	<i>Nereis (Ceratonereis) tunicatae</i>	California, Pacific Ocean
<i>C. vermillionensis</i> (Fauchald, 1972)	<i>Ceratonereis vermillionensis</i>	off western Mexico, Pacific Ocean
<i>C. versipedata</i> (Ehlers, 1887)	<i>Nereis (Ceratonereis) versipedata</i>	Florida Keys, Caribbean Sea, Atlantic Ocean
<i>C. vittata</i> (Langerhans, 1884)	<i>Ceratonereis vittata</i>	Madeira, Atlantic Ocean
<i>C. vulgata</i> (Kinberg, 1866)	<i>Ceratonereis vulgata</i>	Hawaii, Pacific Ocean
Three species added by the present study		
<i>C. tripartita</i> (Horst, 1918) comb. nov. ⁸	<i>Ceratonereis tripartita</i>	Malay Archipelago, Pacific Ocean
<i>C. kumensis</i> sp. nov.	<i>Composetia kumensis</i> sp. nov.	Ryukyu Islands, southern Japan, Pacific Ocean
<i>C. tokashikiensis</i> sp. nov.	<i>Composetia tokashikiensis</i> sp. nov.	Ryukyu Islands, southern Japan, Pacific Ocean

¹ Several paragnaths present on oral ring in the three species, deviating from the generic diagnosis (see also Table 2).² synonymized to *Nereis (Ceratonereis) costae* by Fauvel (1923).³ synonymized to *Nereis (Ceratonereis) costae* by Fauvel (1953).⁴ synonymized to *Ceratonereis (Composetia) costae* by Read and Fauchald (2019) in the online database, based on Hartman (1959).⁵ Since the original description was based on only epitokous specimens, without any more additional description of atokes, further study is needed to confirm whether this species belongs to *Composetia* or not.⁶ Notopodial homogomph falcigers present in posterior chaetigers, deviating from the generic diagnosis (see also Table 2).⁷ Original description and redescription (Pamungkas and Glasby 2015) was based on only epitokous specimens. Atokous morphology was described by Wu *et al.* (1985).⁸ Original description was based on only epitokous specimens. Atokous morphology was described by Fauvel (1932, 1953).

The generic diagnosis presented above is based on not Bakken and Wilson (2005) but Hartmann-Schröder (1985) and Khlebovich (1996), partially modified here to allow for some unique characteristics of the two new species in the present study (see below).

***Composetia kumensis* sp. nov.**
[Japanese name: Kumejima-nagare-gokai]
(Figs 1–3, 4A, 5)

Ceratonereis (Composetia) sp.: Sato 2012: 223.

Composetia sp. B: Sato and Sakaguchi 2016: 85.

Composetia sp. 2: Sato 2017: 483.

Type material. Holotype (NSMT-Pol H-766), female, Gushicha Gusuku on Kume-jima island, Okinawa Prefecture (26°22'52.6"N, 126°45'15.2"E) in the central Ryukyu Islands, southern Japan, 22 November 2013, coll. M. Sato, fixed in 80% ethanol. 17 paratypes: 12 individuals (NSMT-Pol P-767–770), data as for holotype (fixed in 80 or 99% ethanol); two females (NSMT-Pol P-771, 772), locality same as holotype, 24 March 2007, coll. K. Satake, fixed in 10% formalin; three individuals (NSMT-Pol P-773), locality same as holotype, 25 March 1999, coll. K. Satake, fixed in 10% formalin.

Non-type materials examined. One individual, data as for holotype. No longer preserved since whole body used for a DNA analysis (Sato *et al.* 2020) after morphological examination.

Diagnosis. Notoacacula present in first 2 chaetigers. Notopodial prechaetal lobe absent throughout body. Neuro-podial postchaetal lobe present only in anterior body. Upper neurochaetae comprising of homogomph spinigers and heterogomph falcigers throughout, lacking heterogomph spinigers. Lower neurochaetae comprising of heterogomph spinigers and heterogomph falcigers throughout, lacking

homogomph or sesquigomph falcigers. Oral ring greatly enlarged in full-everted proboscis.

Description. Holotype (Figs 1A, 2B–H), complete female, 12 mm BL, 1.0 mm BW, with 53 chaetigers. Paratypes 9–17 mm BL, 0.8–1.5 mm BW, with 49–64 chaetigers.

Body stout almost throughout, tapering around pygidium (Fig. 1A). Dorsum convex, venter relatively flat with longitudinal midventral groove. Colour in live specimens brown with greenish pigmentation on anterior dorsum (Fig. 1B). Colour in preserved specimens whitish cream with brownish or greenish pigmentation on anterior dorsum (Fig. 1A, C).

Prostomium pear-shaped. Antennae short, tapered, separated from each other (Figs 1B, C, 2A). Palps with massive palpophores and short subconical palpostyles. Both pairs of eyes arranged trapezoidally, anterior pair more separated and as large as (or slightly larger than) posterior pair; anterior pair reniform, posterior pair round (Figs 1B, C, 2A). Mid-longitudinal white cleft present on dorsal anterior surface of prostomium (Figs 1B, C, 2A).

Apodous segment (peristomium) slightly longer than subsequent chaetigers, with four pairs of tentacular cirri of unequal length; posterior dorsal tentacular cirri longest, reaching back to chaetiger 10 in holotype (chaetigers 6–14

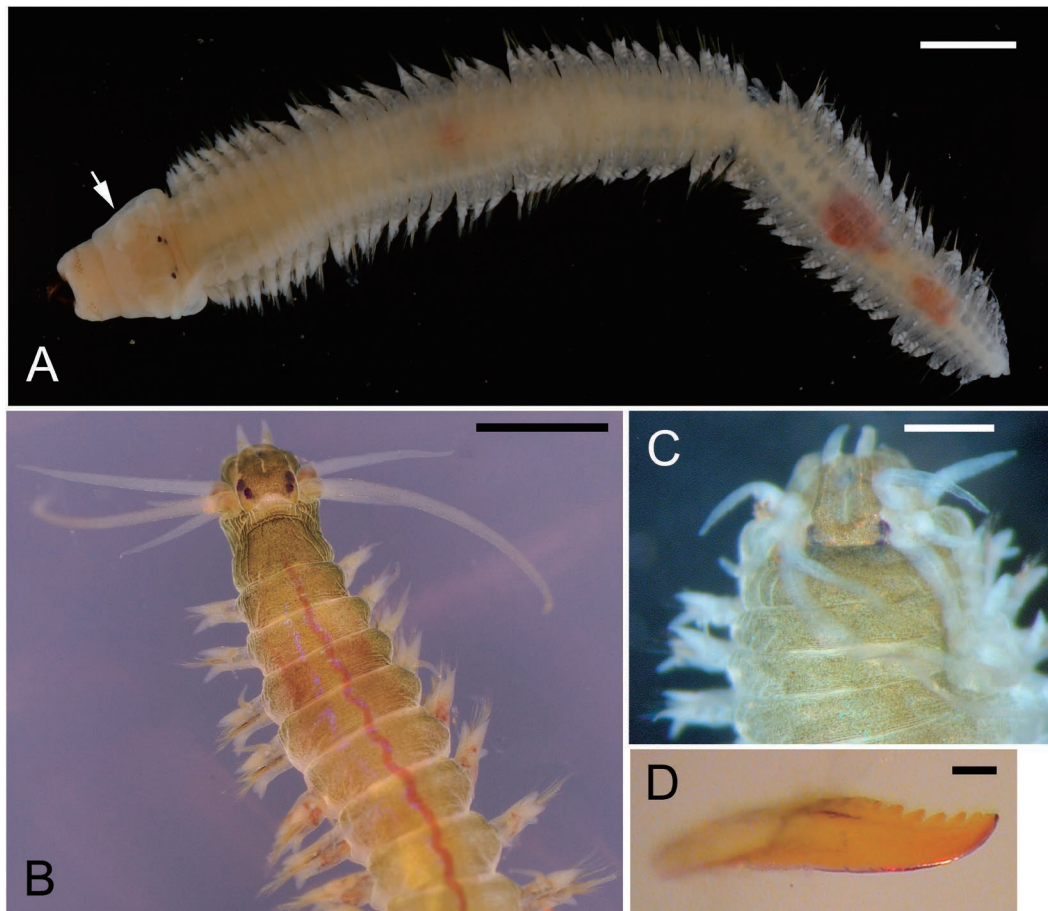


Fig. 1. *Composetia kumensis* sp. nov. A, dorsal view of the whole body of the preserved specimen of holotype (NSMT-Pol H-766). Arrow indicates the enlarged oral ring of the everted proboscis. B, C, paratype (NSMT-Pol P-772): B, dorsal view of the anterior body of a live specimen; C, dorsal view of anterior end of the preserved specimen. D, Jaw of paratype (NSMT-Pol P-773). Scale bars: 1 mm (A, B); 0.5 mm (C); 0.1 mm (D).

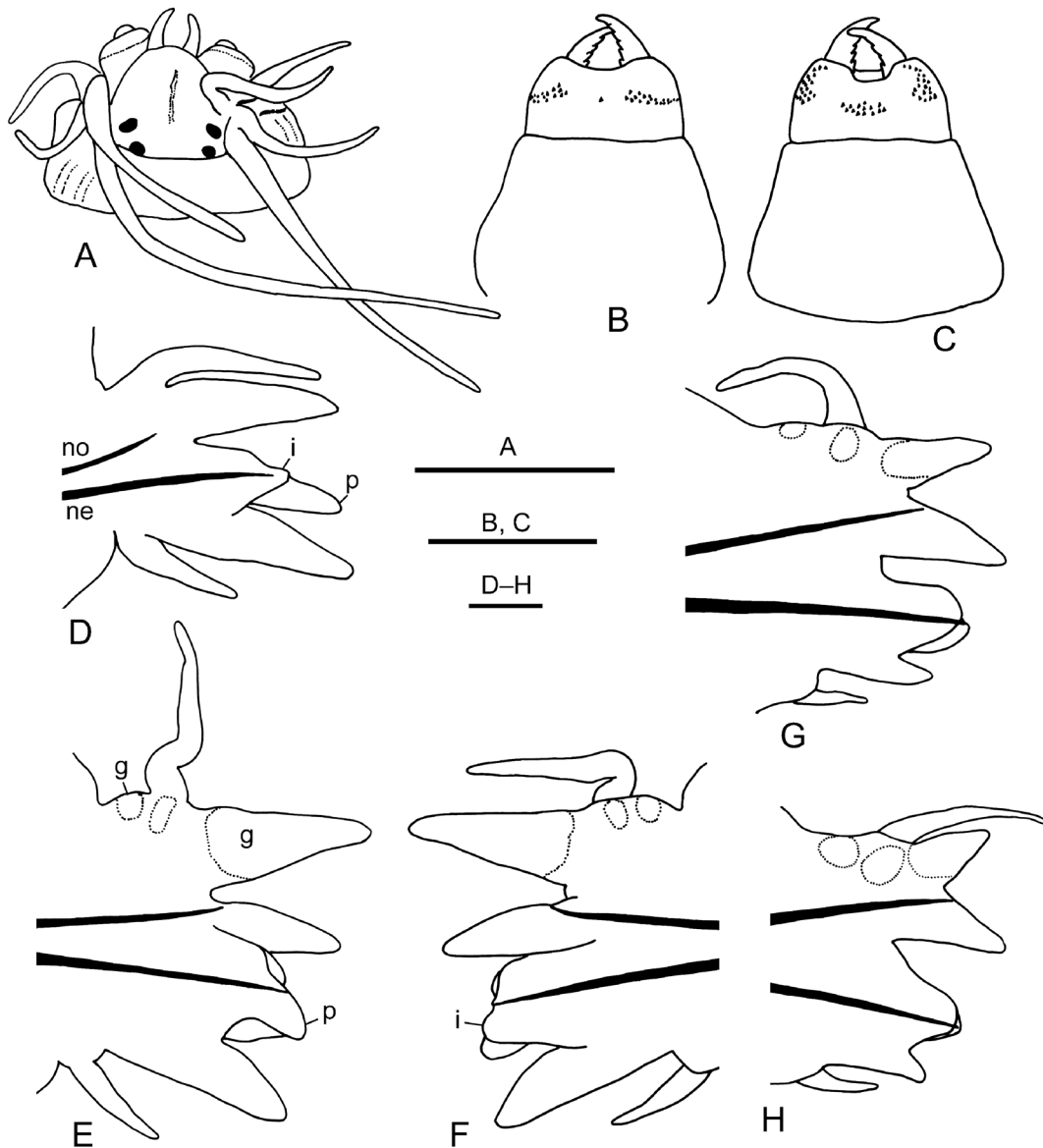


Fig. 2. *Compositetia kumensis* sp. nov. A, dorsal view of prostomium and peristomium of a paratype (NSMT-Pol P-772). B–H, holotype (NSMT-Pol H-766): B, dorsal view of the everted proboscis; C, ventral view of the everted proboscis; D, anterior view of left parapodium 1; E, posterior view of right parapodium 5; F, anterior view of right parapodium 5; G, posterior view of right parapodium 20; H, posterior view of right parapodium 41. Abbreviations: g, glandular patch; i, neuropodial inferior lobe; ne, neuroacicula; no, notoacicula; p, neuropodial postchaetal lobe. Scale bars: 1 mm (A–C); 0.1 mm (D–H).

in paratypes, usually chaetigers 10–14).

Proboscis with pair of amber jaws, each with around 6 marked teeth (Fig. 1D). Brown paragnaths with usually sharply pointed tip present only on maxillary ring (Fig. 2B, C). Paragnath numbers in holotype (range for all type series in parentheses): area I: 1 (0–2, $n=18$); area II: 24 on each side in two or three arched rows, total 48 (40–59, $n=17$); area III: 14 (13–25, $n=17$) in ovoid patch along base of maxillary ring; area IV: 20 on left and 19 on right, in triangular patch, total 39 (21–52, $n=16$). Oral ring greatly enlarged into trapezoidal shape in full-everted proboscis, 2.2 times longer and 1.6 times wider than maxillary ring in holotype, without any paragnaths or papillae (Figs 1A, 2B, C).

Parapodia most enlarged around chaetigers 5–10 (Fig. 2E, F). Sub-biramous parapodia of first 2 chaetigers with thin

notoacicula (Fig. 2D). Notopodial dorsal ligule conical with tapering tip throughout. Notopodial prechaetal lobe absent throughout. Notoacicular process absent throughout. Notopodial ventral ligule conical with tapering tip throughout, subequal to or slightly smaller than notopodial dorsal ligule throughout. Dorsal cirri slender, tapering, as long as or longer than notopodial dorsal ligule throughout. Three whitish glandular patches present on dorsal edge of notopodia; distalmost glandular patch larger than others, covering whole conical projection of notopodial dorsal ligule throughout (Fig. 2E–H).

Neuropodial postchaetal lobe with tapering tip present in first 8 chaetigers in holotype (6–10 chaetigers in paratypes), absent in following chaetigers. Superior lobe in acicular ligule absent throughout. Inferior lobe conical in anterior

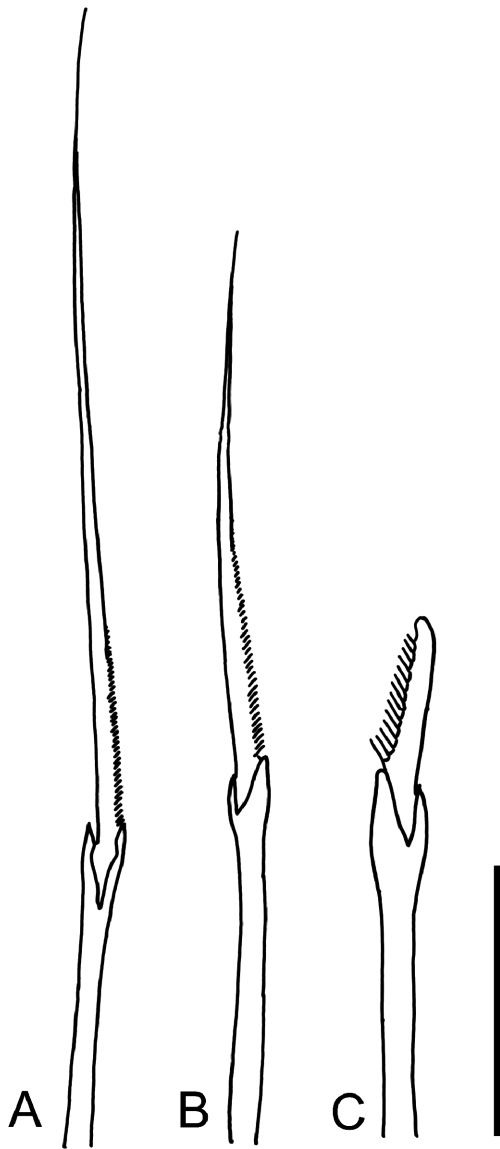


Fig. 3. Chaetae in chaetiger 20 of paratype (NSMT-Pol P-771) of *Compositia kumensis* sp. nov. A, homomorph spiniger from notochaetae; B, heteromorph spiniger from lower neurochaetae; C, heteromorph falciger from upper neurochaetae. Scale bar: 0.05 mm.

parapodia, diminishing in middle parapodia, absent in posterior parapodia (Fig. 2D, F–H). Ventral ligule conical with tapering tip throughout, diminishing from middle parapodia, shorter than neuroacicular ligule. Ventral cirrus slender with tapering tip, not beyond ventral ligule throughout.

Notochaetae all homomorph spinigers, having long blades with finely serrated edge (Figs 3A, 4A); in holotype, 7, 4, and 3 spinigers present in chaetigers 5, 20, and 41, respectively; up to 11 spinigers in paratypes.

Upper neurochaetae consisting of homomorph spinigers and heteromorph falcigers (Fig. 4A) throughout. Heteromorph falcigers with short finely-serrated blades located at superior/anterior position; in holotype, 4, 3, 2, and 2 falcigers present in chaetigers 1, 5, 20, and 41, respectively; up to 6 falcigers in paratypes. Homomorph spinigers with long finely-serrated blades located at posterior position; in holotype, 3, 5, 4, and 3 spinigers present in chaetigers 1, 5, 20,

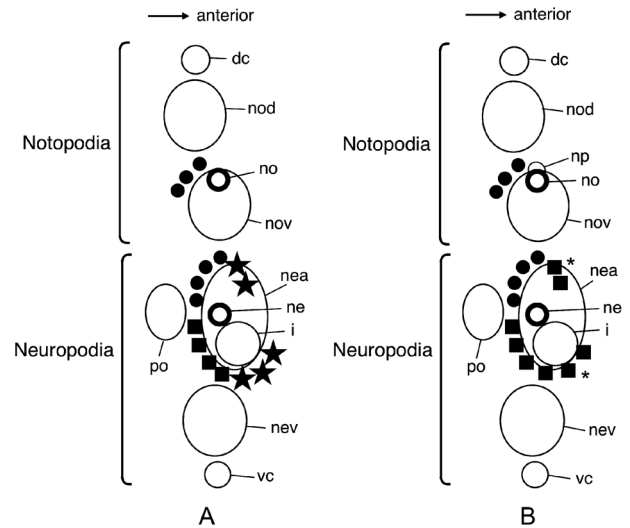


Fig. 4. Schematic diagrams of chaetal arrangement in distal view of right parapodium around chaetiger 5. A, *Compositia kumensis* sp. nov. B, *C. tokashikiensis* sp. nov. Closed circles: homomorph spinigers. Closed squares: heteromorph spinigers. Closed stars: heteromorph falcigers. Asterisks indicate that few heteromorph falcigers are sometimes present. Abbreviations: dc, dorsal cirrus; i, neuropodial inferior lobe; ne, neuroacicula; nea, neuropodial acicular lobe; nev, neuropodial ventral ligule; no, notoacicula; nod, notopodial dorsal ligule; np, notoacicular process; nov, notopodial ventral ligule; po, neuropodial postchaetal lobe; vc, ventral cirrus.

and 41, respectively; up to 12 spinigers in paratypes.

Lower neurochaetae consisting of heteromorph spinigers and heteromorph falcigers (Fig. 4A) throughout. Heteromorph falcigers with short finely-serrated blades (Fig. 3C) located at inferior/anterior position; in holotype, 6, 10, 4, and 1 falcigers present in chaetiger 1, 5, 20, and 41, respectively; up to 11 falcigers in paratypes. Heteromorph spinigers with finely-serrated blades (Fig. 3B) located at posterior position; in holotype, 7, 7, 4, and 3 spinigers present in chaetiger 1, 5, 20, and 41, respectively; up to 12 spinigers in paratypes.

Pygidium with anus on dorsal side, with slender anal cirri.

Small oocytes (50–75 μm in diameter) present in coelom of holotype.

Variations. In our subsequent extensive surveys, additional specimens of this species were collected from 10 additional sites on five islands in the Ryukyu Islands. The variations of morphological characteristics among the geographically separated populations will be shown in a subsequent paper (Sato *et al.* 2020).

Reproduction. The coelom of two paratype specimens (NSMT-Pol P-771, 772) collected in March in 2007 was filled with large oocytes (about 250 μm and 150 μm , respectively, in maximum diameter). None of the specimens show epitokous metamorphosis.

Habitat. Sandy bottom with pebbles in a small creek originating from a freshwater spring within the upper intertidal zone of the uplifted coral reef, surrounded by salt-marsh vegetation (Fig. 5). Based on my field survey on 22 and 23 November 2013 in the type locality in Kume-jima



Fig. 5. Landscape of the type locality of *Compositia kumensis* sp. nov. at the uplifted coral reef at Gushicha Gusuku on Kume-jima island (photographed on 22 November 2013). A, overview of the uplifted coral reef around the sampling site; B, the sampling site in a small creek originating from a freshwater spring (arrow) in the upper intertidal zone of the uplifted coral reef, surrounded by salt-marsh vegetation. Scale bar in B: 1 m.

island and daily tidal records of observed sea level in Naha, Okinawa-jima island, close to Kume-jima (Japan Meteorological Agency 2019), the habitat condition was judged as follows: living usually under fresh-water conditions, which drastically changes to a marine regime during the most extreme spring high tides for a few days in a month (around 6 days in November 2013), with salinities ranging from 0.2 to 33.1 psu and temperatures from 19.2°C to 22.6°C.

Etymology. The species name is an adjective derived from the island name of the type locality, Kume-jima.

***Compositia tokashikiensis* sp. nov.**

[New Japanese name: Tokashiki-nagare-gokai]
(Figs 4B, 6–8)

Compositia sp. A: Sato and Sakaguchi 2016: 85.

Compositia sp. 1: Sato 2017: 483.

Type material. Holotype (NSMT-Pol H-774), female, the upper reaches of a small estuary in the Tokashiki-gawa river on Tokashiki-jima island, Okinawa Prefecture (26°11'46.81"N, 127°21'46.82"E) in the central Ryukyu Is-

lands, southern Japan, 20 November 1991, coll. M. Sato, fixed in 80% ethanol. 18 paratypes: 9 individuals (NSMT-Pol P-775–783), data as for holotype; 9 individuals (NSMT-Pol P-784), locality same as holotype, 27 May 2012, coll. M. Sato, fixed in 80% ethanol.

Non-type materials examined. Two individuals, data as for holotype. No longer preserved since whole body used for a DNA analysis (Sato *et al.* 2020) after morphological examination.

Diagnosis. Notoacicula present in first 2 chaetigers. Notopodial prechaetal lobe absent throughout body. Neuropodial postchaetal lobe present only in anterior body. Upper neurochaetae comprising of homogomph spinigers and heterogomph falcigers except for around first 20 chaetigers, where most or all of heterogomph falcigers replaced by heterogomph spinigers. Lower neurochaetae comprising of heterogomph spinigers and heterogomph falcigers except for around first 20 chaetigers, where most or all of heterogomph falcigers replaced by heterogomph spinigers. Oral ring greatly enlarged in full-everted proboscis.

Description. Holotype (Figs 6A, 7D–G, 8A–C), complete female, 19 mm BL, 1.5 mm BW, with 59 chaetigers (Fig. 6A). Paratypes 15–21 mm BL, 1.0–1.6 mm BW, with 57–63 chaetigers.

Body stout almost throughout, tapering around pygidium. Dorsum convex, venter relatively flat with longitudinal midventral groove. Colour in live specimens brownish. Colour in preserved specimens whitish cream with brownish pigmentation on anterior dorsum.

Prostomium pear-shaped or triangular. Antennae short, tapered, separated from each other (Figs 6B, C, 7A). Palps with massive palpophores and short subconical palpostyles. Both pairs of eyes arranged trapezoidally, anterior pair reniform, more separated and as large as (or larger than) posterior pair; posterior pair round. Mid-longitudinal white cleft present on dorsal anterior surface of prostomium, bordered by dark pigmentation.

Apodous segment slightly longer than subsequent chaetigers, with four pairs of tentacular cirri of unequal length; posterior dorsal tentacular cirri longest, reaching back to chaetiger 8 in holotype (chaetigers 6–12 in paratypes, usually chaetigers 6–10) (Fig. 7A).

Proboscis with pair of amber jaws, each with 8 marked teeth in holotype (7–9 teeth in paratypes). Brown paragnaths usually with sharply pointed tip present only on maxillary ring (Figs 6C, D, 7B, C). Paragnath numbers in holotype (range for all materials in parentheses): area I: 0 (0–0, $n=21$); area II: 26 on left and 24 on right in two or three arched rows, total 50 (35–58, $n=21$); area III: 23 (14–25, $n=21$) in ovoid patch along base of maxillary ring; area IV: 22 on left and 21 on right in triangular patch, total 43 (16–47, $n=20$). Oral ring greatly enlarged into trapezoidal shape in full-everted proboscis, 1.7 times longer and 1.8 times wider than maxillary ring in holotype, without any paragnaths or papillae (Figs 6A–D, 7C).

Sub-biramous parapodia of first 2 chaetigers with thin notoacicula (Fig. 7D). Notopodial dorsal ligule conical with tapering tip throughout. Notopodial prechaetal lobe absent

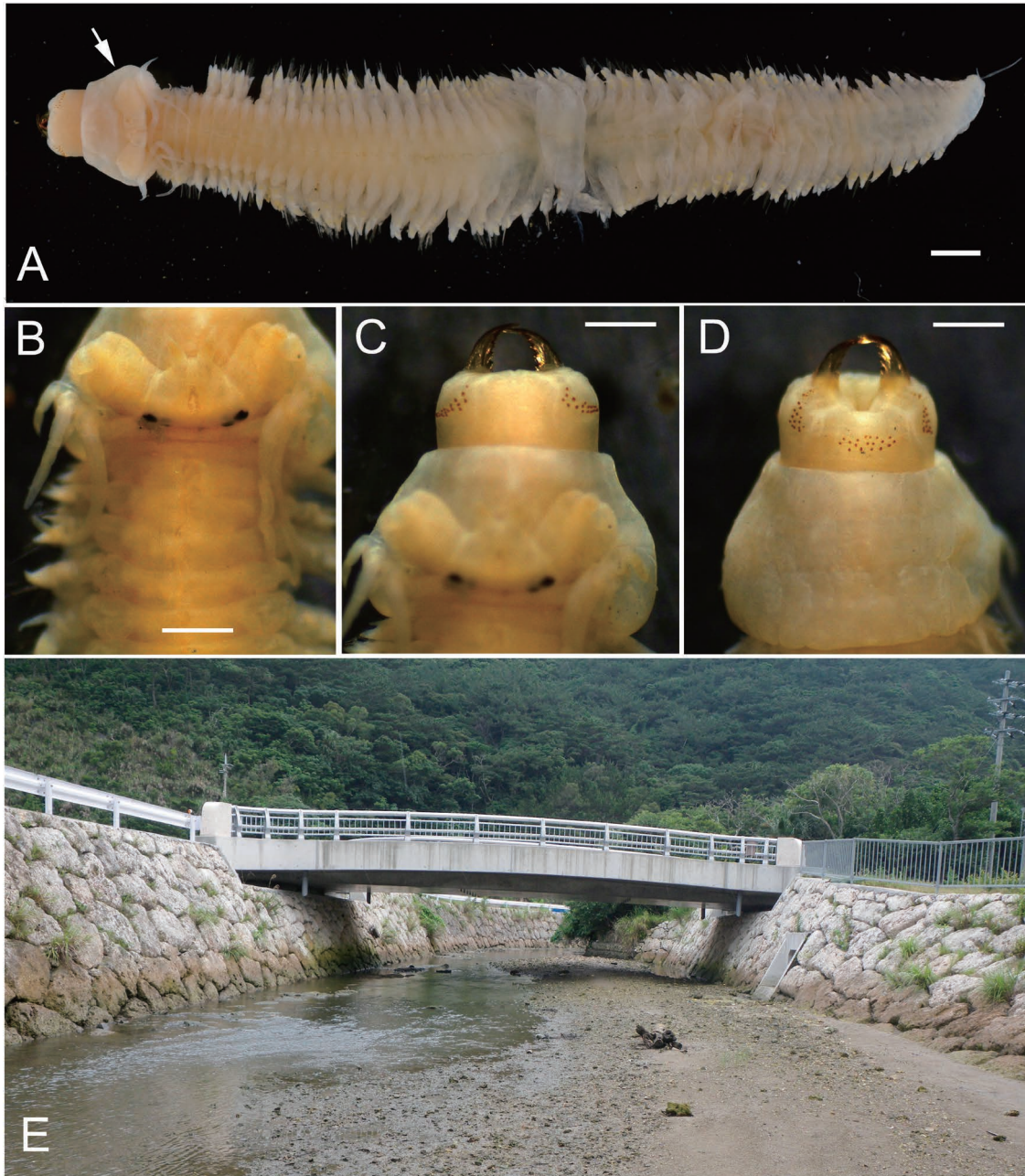


Fig. 6. *Compositia tokashikiensis* sp. nov. A, dorsal view of the whole body of the preserved specimen of holotype (NSMT-Pol H-774). Arrow indicates the enlarged oral ring of the everted proboscis. B–D, anterior end of a paratype (NSMT-Pol P-783): B, dorsal view of prostomium, peristomium, and anterior chaetigers; C, dorsal view of the everted proboscis; D, ventral view of the everted proboscis. E, landscape of the type locality at the upper reaches of a small estuary in the Tokashiki-gawa river in Tokashiki-jima island (photographed on 27 May 2012). Scale bars: 1 mm (A); 0.5 mm (B–D).

throughout. Notoacicular process present in few parapodia in chaetigers 5–10 in holotype and some large paratypes more than 1.5 mm BW (Fig. 7F). Notopodial ventral ligule conical with tapering tip throughout, shorter than notopodial dorsal ligule in anterior parapodia and subequal to that in posterior parapodia. Dorsal cirri slender, tapering, as long as or shorter than notopodial dorsal ligule throughout, except for posteriormost few parapodia where dorsal cirri longer than notopodial dorsal ligule. Three whitish glandular patches present on dorsal edge of notopodia; distalmost glandular patch larger than others, covering whole conical projection of notopodial dorsal ligule throughout (Fig.

7E–H).

Neuropodial postchaetal lobe with tapering tip present in first 18 chaetigers in holotype (12–25 chaetigers in paratypes) (Fig. 7D–F), absent in following chaetigers (Fig. 7G, H). Superior lobe in acicular ligule absent throughout. Inferior lobe conical in anterior parapodia, diminishing in middle parapodia, and absent in posterior parapodia (Fig. 7D–H). Ventral ligule conical with tapering tip throughout, diminishing from middle parapodia, shorter than neuracicular ligule. Ventral cirrus slender with tapering tip, shorter than ventral ligule throughout.

Notochaetae all homogomph spinigers, having long

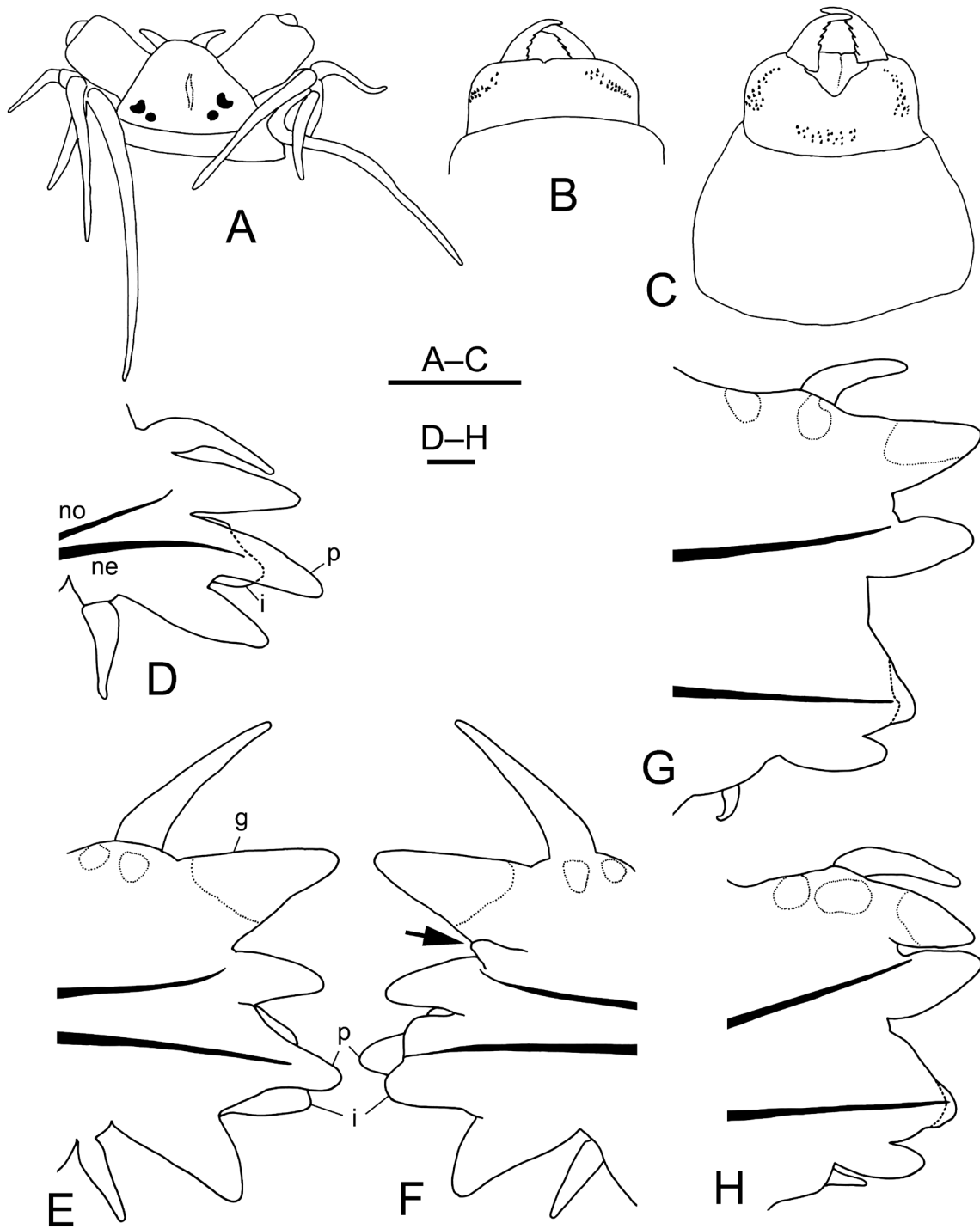


Fig. 7. *Compositia tokashikiensis* sp. nov. A–C, paratype (NSMT-Pol P-775): A, dorsal views of prostomium and peristomium; B, dorsal view of the everted proboscis; C, ventral view of the everted proboscis. D–G, holotype (NSMT-Pol H-774): D, posterior view of right parapodium 1; E, posterior view of right parapodium 5; F, anterior view of right parapodium 5; G, posterior view of right parapodium 32. H, posterior view of right parapodium 51 of the paratype (NSMT-Pol P-775). Arrow indicates a notoacicular process. Abbreviations: g, glandular patch; i, neuropodial inferior lobe; ne, neuroacicula; no, notoacicula; p, neuropodial postchaetal lobe. Scale bars: 1 mm (A–C); 0.1 mm (D–H).

blades with finely serrated edge (Fig. 8A); in holotype, 3, 8 and 6 spinigers present in chaetiger 3, 5 and 32, respectively; up to 11 spinigers in paratypes.

Upper neurochaetae consisting of homogomph spinigers and heterogomph falcigers except for anterior chaetigers (around first 20 chaetigers), where most or all of heterogomph falcigers replaced by heterogomph spinigers (Fig.

4B). Heterogomph falcigers with short finely-serrated blades located at superior/anterior position; in holotype, no falcigers present in chaetigers 3 and 5; up to 3 falcigers in paratypes; in holotype, 3 falcigers present in chaetiger 32; up to 3 falcigers in paratypes. Heterogomph spinigers with short finely-serrated blades (Fig. 8B) present only in anterior chaetigers (most abundant around chaetiger 5); in holotype,



Fig. 8. Chaetae of *Compositia tokashikiensis* sp. nov. A–C, chaetae in parapodium 5 of the holotype (NSMT-Pol H-774): A, homogomph spiniger of notochaetae; B, heterogomph spiniger with short blade from upper neurochaetal bundle; C, heterogomph spiniger with long blade from lower neurochaetal bundle (upper position). D, E, chaetae in parapodium 43 of paratype (NSMT-Pol P-775): D, heterogomph spiniger with short blade from lower neurochaetal bundle (lower position); E, heterogomph falciger from lower neurochaetal bundle. Scale bar: 0.05 mm.

4 and 6 spinigers present in chaetigers 3 and 5, respectively; up to 9 spinigers in paratypes. Homogomph spinigers with long finely-serrated blades located at posterior position; in holotype, 6, 8 and 5 spinigers present in chaetigers 3, 5 and 32, respectively; up to 10 spinigers in paratypes.

Lower neurochaetae consisting of heterogomph spinigers and heterogomph falcigers except for anterior chaetigers (around first 20 chaetigers), where most or all of heterogomph falcigers replaced by heterogomph spinigers (Fig. 4B). Heterogomph falcigers with short serrated blades (Fig. 8E) located at inferior/anterior position; in holotype, no falcigers present in chaetigers 3 and 5; up to 2 falcigers in paratypes; in holotype, 2 falcigers present in chaetiger 32; up to 6 falcigers in paratypes. Heterogomph spinigers with finely-serrated blades present throughout (most abundant around chaetiger 5); in holotype, 12, 18 and 7 spinigers present in chaetigers 3, 5 and 32, respectively; up to 21 and 12 spin-

gers in anterior and middle chaetigers, respectively, in paratypes; spinigers with long blades (Fig. 8C) located at posterior position; spinigers with short blades (Fig. 8D) located at inferior/anterior position.

Pygidium with anus on dorsal side, with slender anal cirri.

Variations. In our subsequent extensive surveys, additional specimens of this species were collected from 20 additional sites on six islands in the Ryukyu Islands, and also from a site in Thailand. The variations of morphological characteristics among the geographically separated populations will be shown in a subsequent paper (Sato *et al.* 2020).

Reproduction. The coelom of a paratype specimen (NSMT-Pol P-775) collected in November in 1991 was filled with large oocytes (about 250 μ m in maximum diameter). None of the specimens show epitokous metamorphosis.

Habitat. Intertidal sandy bottom in the upper reaches of a small estuary (Fig. 6E). Salinity of interstitial water that drained into the remaining holes after taking the sediment samples was 0.3 psu at a low tide around 16:00 on 27 May 2012.

Etymology. The species name is an adjective derived from the island name of the type locality, Tokashiki-jima.

Remarks. *Compositia tokashikiensis* sp. nov. is distinguishable from *C. kumensis* sp. nov. by the arrangement of neurochaetae in anterior chaetigers around chaetiger 5, where heterogomph falcigers are mostly or completely replaced by heterogomph spinigers with short blades in both upper and lower fascicles of neurochaetae.

Discussion

In the present study, two new species of *Compositia* (*C. kumensis* sp. nov. and *C. tokashikiensis* sp. nov.) were described based on specimens collected from small estuaries in the central Ryukyu Islands, southern Japan. The two new species are distinguishable from all other congeners by some key characters including the following diagnostic characters for the new species: the presence of notoacacula in chaetigers 1 and 2; the absence of notopodial prechaetal lobe throughout; the presence of neuropodial postchaetal lobe only in anterior body; neurochaetae consisting of homogomph and heterogomph spinigers and heterogomph falcigers; and greatly enlarged oral ring in the full-everted proboscis. Table 2 shows a summary of the comparison of diagnostic characteristics of 25 species of *Compositia* recorded from Indo-Pacific Ocean, including *C. burmensis* that was synonymized to *Neanthes glandicincta* by Lee and Glasby (2015).

Most of *Compositia* are marine species; only four species, *C. bundaiensis*, *C. burmensis*, *C. keiskama* (Day, 1953) and *C. microcephala* (Grube, 1878) have been previously known as non-marine species, collected from estuaries (Table 2). *Compositia keiskama*, which occurred in estuarine waters of “very low salinity” in South Africa (Day 1953), is similar to the Japanese two new species in major diagnostic characteristics, though it is unknown whether *C. keiskama* has noto-

Table 2. Comparison of characteristics of 25 species of *Composetia* recorded from Indo-Pacific Ocean, including *C. burmensis* (Monro, 1937) that was synonymized to *Neanthes glandicincta* Southern, 1912.

Species	Distribution in Pacific and Indian Oceans	Habitat	Serration of jaws	Notoacicula in first 2 chaetigers	Notopodial prechaetal lobe	Neuropodial homogomph falcigers	Neuropodial heterogomph or sesquigomph falcigers	Other diagnoses	References
<i>C. beringiana</i>	western Bering Sea, 510–4400 m in depth	marine	present	?	absent	?	?	eyes absent; a few paragnaths present in oral ring.	Levenstein (1961)
<i>C. bundaiensis</i>	west central Taiwan	estuarine mudflats	present	absent	present	absent	present	falcigers present only in posterior body.	Hsueh (2018)
<i>C. burmensis</i>	India, Myanmar, Singapore, Malaysia	estuary	present	absent	present	absent	present	sometimes few minute paragnaths present in oral rings; falcigers present in middle body; oral ring enlarged.	Southern (1921); Monro (1937); Lee and Glasby (2015); Ibrahim <i>et al.</i> (2019)
<i>C. coracina</i>	Philippines, Singapore	?	present	?	absent	?	?	unusual small notopodial dorsal ligule.	Grube (1878)
<i>C. costae</i>	coasts of Indian Ocean, South China Sea, Japan	marine	present	absent	present in anterior parapodia	absent	present	1 or 2 stout falcigers with a short blade present in posterior body; 0 or 1 paragnath present in area I.	Fauvel (1953); Wu <i>et al.</i> (1985); Imajima (2003, 2015)
<i>C. dubia</i>	New Caledonia	marine	present	?	absent	absent	present	a row of 10 paragnaths in area II; curved tip of falcigers.	Rullier (1972)
<i>C. dunckeri</i>	New Pomerania	marine	present	?	absent	absent	present	notopodial homogomph falcigers present in posterior body.	Augener (1925)
<i>C. fakaravae</i>	Tuamotu Islands	marine	inconspicuous	?	present	?	?	short tentacular cirri.	Chamberlin (1919)
<i>C. flagellipes</i>	Ganjam Coast, India, 93 fms in depth	marine	present	?	absent	absent	present	parapodial ligules flagelliform in middle body.	Fauvel (1932, 1953)
<i>C. gorbunovi</i>	Okhotsk Sea, 182–335 m in depth	marine	present	?	present	?	?	5 or 6 large paragnaths present in area VII–VIII.	Uschakov (1965)
<i>C. hircinicola</i>	Indian Ocean, China, Korea, Japan	marine	present	?	absent (Japan), or present (China, Korea)	absent	present	heterogomph spinigers absent.	Imajima (1972); Wu <i>et al.</i> (1985); Paik (1989); Imajima (1996, 2003)
<i>C. hyaloagnatha</i>	Amboina in Indonesia	marine	present	?	absent	absent	present	red-brown longitudinal stripe in dorsum; homogomph spiniger absent in neuropodia.	Ehlers (1920)
<i>C. keiskama</i>	coast of South Africa	estuary (very low salinity)	present	?	absent	absent	present	notopodial dorsal ligule reduced in posterior body; oral ring enlarged.	Day (1953)
<i>C. marmorata</i>	Indonesia, Vietnam, southern China	marine	present	?	absent	absent	present	heterogomph spinigers absent.	Horst (1924); Wu <i>et al.</i> (1985)

Table 2. Continued.

Species	Distribution in Pacific and Indian Oceans	Habitat	Serration of jaws	Notoacacula in first 2 chaetigers	Notopodial prechaetal lobe	Neuropodial homogomph falcigers	Neuropodial heterogomph or sesquigomph falcigers	Other diagnoses	References
<i>C. microcephala</i>	Philippines	?	absent	?	?	?	?	metamorphosing to heteronereid form; small prostomium.	Grube (1878)
<i>ditto</i>	Taleh-Sap, Gulf of Siam	estuary	?	?	absent	present in anterior parapodia	absent	oral ring enlarged.	Fauvel (1932, 1953)
<i>C. monronis</i>	Galapagos	Marine (shallow sublittoral)	present	absent	present in anterior parapodia	present	present	notopodial homogomph falcigers present in posterior body.	Westheide (1977)
<i>C. moorei</i>	Central Japan and Kurile Islands	marine	present	?	present	absent	present	jaws with 3 teeth in basal half and 1 double tooth near apical fang.	Moore (1903); Izuka (1912); Imajima (1972, 1996)
<i>C. paucidentata</i>	north of the Aleutian Islands, Bering Sea	marine	present	?	absent	absent	present	3 small paragnaths present in area VII–VIII; stout falcigers present in neuropodia.	Moore (1903)
<i>C. pietschmanni</i>	Hawaii	marine	present	present	absent	absent	present	slender ligules in anteriormost parapodia.	Holly (1935)
<i>C. tripartita</i>	Malay Archipelago, Andaman Islands	marine	present	?	absent	absent	present	stout falcigers present in neuropodia.	Horst (1918, 1924); Fauvel (1932, 1953)
<i>C. tunicatae</i>	California	marine	present	?	absent	?	?	notopodial homogomph falcigers present in posterior body.	Hartman (1936)
<i>C. vermillionensis</i>	off western Mexico	marine	present	absent	absent	absent	present only in upper fascicles	eyes absent; notopodial dorsal ligule reduced in posterior body.	Fauchald (1972)
<i>C. vulgata</i>	Hawaii	marine	present	?	present in anterior parapodia	absent	present	short blade of falcigers with crochethlike tip.	Kinberg (1866); Hartman (1949)
<i>C. kumensis</i> sp. nov.	Ryukyu Islands, Japan	estuary	present	present	absent	absent	present	heterogomph spiniger absent among upper neurochaetae; oral ring enlarged.	Present study
<i>C. tokashikiensis</i> sp. nov.	Ryukyu Islands, Japan	estuary	present	present	absent	absent	present	heterogomph spinigers present among upper neurochaetae around chetiger 5; oral ring enlarged.	Present study

acicula in chaetigers 1 and 2 or not. However, *C. keiskama* differs from the two new species in terms of extremely reduced notopodial dorsal ligule in posterior parapodia. *Composetia microcephala*, which was recorded from Philippines (type locality, with no information about the habitat) and an estuarine lake (Taleh-Sap) in Thailand (Fauvel 1932, 1953), is also somewhat similar to the two new species. However, *C. microcephala* differs from the two new species in terms of jaws with a smooth edge and the presence of homogomph falcigers in the anterior neuropodia. *Composetia bundaiensis* differs from the two new species in terms of the absence of notoacicula in chaetigers 1 and 2, the presence of notopodial prechaetal lobe and the presence of long sesquigomph falcigers only in posterior neuropodia. *Composetia burmensis* differs from the two new species in terms of the absence of notoacicula in chaetigers 1 and 2, the presence of notopodial prechaetal lobe and few minute paragnaths present sometimes in the oral ring. It is interesting that the unique characteristic of the enlarged oral ring of the proboscis is shared among the five estuarine species, *i.e.*, *C. burmensis* (as *N. glandicincta*; Southern 1912), *C. keiskama* (Day 1953: text-fig. 5B, C), *C. microcephala* (specimens from Thailand; Fauvel 1932, 1953) and the two new species (present study), though its functional meaning is unknown.

Key to species of *Composetia* recorded from Japan

- 1 Notopodial prechaetal lobe present in anterior chaetigers 2
- Notopodial prechaetal lobe absent throughout 3
- 2 Jaws with three teeth in basal half separated by wide interval from double tooth near apical fang; 5 paragnaths in longitudinal series in area I *C. moorei*
- Jaws with four teeth without separated double tooth; 0 or 1 paragnath present in area I *C. costae*
- 3 Neuropodial heterogomph spinigers absent throughout *C. hircinicola*
- Neuropodial heterogomph spinigers present throughout 4
- 4 Heterogomph spinigers present among upper neurochaetae around chaetiger 5. . . *C. tokashikiensis* sp. nov.
- Heterogomph spinigers absent among upper neurochaetae throughout *C. kumensis* sp. nov.

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