

A NEW SPECIES OF *PARASPADELLA*
(CHAETOGNATHA) FROM THE
COASTAL WATERS OF JAPAN

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Abstract.—A new species of the benthic chaetognath genus *Paraspadella*, *P. gotoi*, is described from Amakusa Island, Japan. It differs from the hitherto known species mainly by the shape of adhesive organs and seminal vesicles and the ventral position of the female genital orifices.

During the first workshop on chaetognaths held in the University of Surrey (Great Britain) in September 1988, Dr. Tai-chiro Goto (Mie University, Japan) gave me several specimens of a *Paraspadella* that looked like *P. schizoptera* Conant, 1895 but which appeared to him to be different from this species. Indeed, it is a new species and thus named *P. gotoi*.

Paraspadella gotoi, new species
Figs. 1-2, Table 1

The holotype and four paratypes are deposited in the National Science Museum Tokyo (NSMT-Ch. 006 and 007-010 respectively). Other paratypes are presented to the Muséum national d'Histoire Naturelle, Paris (UC 96) and to the National Museum of Natural History, Washington, D.C. (USNM 128300). All were collected in April 1987 and 1988.

Description.—Eighteen specimens studied. Body stumpy (Fig. 1), reaching up to 5.9 mm without tail fin. Caudal segment represents 46.5 to 51% of body length.

Head bears 8 to 10 very recurved hooks. Anterior teeth only, 4-6 on each side, thin and long, the second innermost being the longer (Fig. 2d). Eyes large, with a large four or three branched pigmented cell (Fig. 2e). Corona ciliata unique and easier to describe with a drawing and photographs (Figs. 1a, 2f, g, h): outline of the three lengthened parts very irregular, one extending towards the

eyes and the two others on both sides of neck. Thick collarete stretching from the neck to the end of caudal segment, covered with numerous sensory tufts. Numerous colored pits (dark grey or brownish yellow) arranged in symmetrical areas on the dorsal and lateral sides from head to tail. Gut sinuous, of a brick reddish color. Well-marked intestinal diverticula at the level of neck, clearly visible since the body is rather transparent. Longitudinal muscles not strongly developed as in other spadellids and lateral fields rather wide. Transverse musculature extends from neck to end of trunk. Ventral ganglion large, occupying about one third of trunk length.

Lateral fins divided into two parts, a small one (length ≈ 0.7 mm) before the female genital orifice and a considerably larger one, extending from this orifice to seminal vesicle. Different directions of rays in the small part and in the beginning of the larger one (Fig. 2i) seem to indicate that there are in fact two pairs of lateral fins as in *Paraspadella schizoptera*. Caudal fin spatulate; all fins completely provided with rays.

Two adhesive organs on each side meet and unite on half their length at level of anterior part of the seminal vesicle; finger-like processes which constitute each adhesive organ themselves united so that adhesive organs look like a cockscomb surrounding ventrally each seminal vesicle (Fig. 1b).

Ovaries reaching the level of neck when

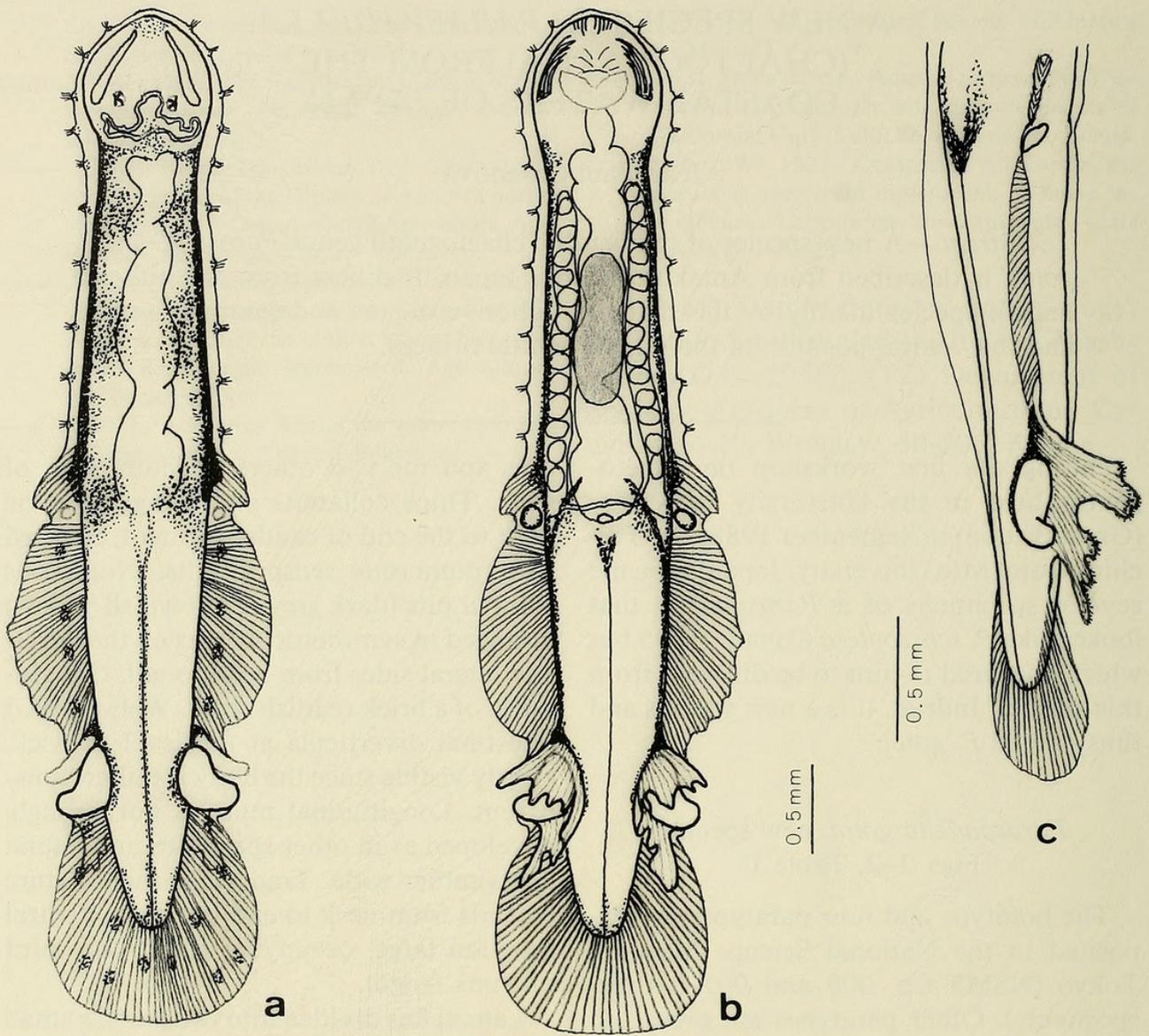


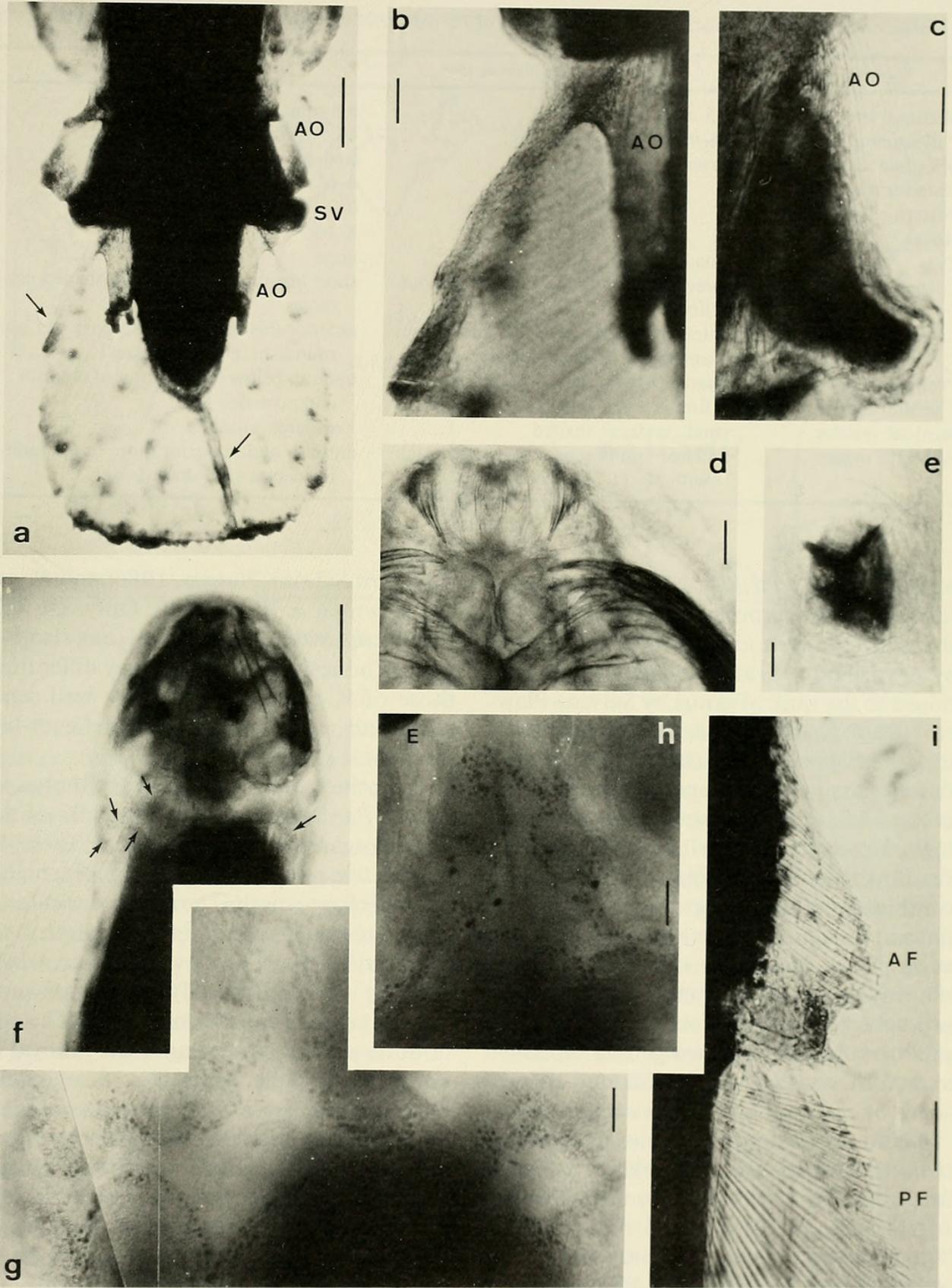
Fig. 1. *Paraspadella gotoi*, n. sp.: a, Dorsal view; b, Ventral view; c, Right lateral view, with pigmented areas. In a, sensory tufts on fins are stained with methylene blue.

fully mature and filled with about twenty large ova of 0.20–0.22 mm in diameter arranged into two rows (only one row when small). Ovaries connected near their base by a duct surrounding ventrally the intestine as already described in three other species of *Paraspadella* (Conant 1895, Mawson

1944) and in *Heterokrohnia* and *Archeterokrohnia* (Casanova 1985, 1986). Female genital orifices ventral with regard to lateral fins (Fig. 1b, c). Seminal vesicles crooked, their orifice at the top of a stout tube perpendicular to the axis of tail (Fig. 2c).

Comparisons with other species.—Species

Fig. 2. *Paraspadella gotoi*, n. sp.: a, Ventral view of caudal segment showing adhesive organs and seminal vesicles. Arrows indicate the thickenings on the tail fin analogous to the finger-like processes of the adhesive organs; b, Enlargement of the right part of the tail fin showing that the thickened edge is an extension of the adhesive organ; c, Seminal vesicle (rays of the anterior part of the adhesive organ laying above the vesicle are visible); d, Teeth and tips of hooks; e, Right eye; f, Dorsal view of the anterior part of a mature specimen (black



area in the trunk = ovaries) showing the corona ciliata (arrows); g, Enlargement of the corona ciliata; h, Central part of the corona ciliata of another specimen; i, Anterior and posterior fins with rays in different directions. AF = anterior fins, AO = adhesive organs, E = eyes, PF = posterior fins, SV = seminal vesicles. Scale bars: 0.25 mm (a, f, i), 0.05 mm (b, c, d, g, h) and 0.02 mm (e).

Table 1.—Diagnostic characters of the two species of *Paraspadella* with two pairs of adhesive organs.

Characteristics	<i>Paraspadella sheardi</i> Mawson, 1944	<i>Paraspadella gotoi</i> , n. sp.
Maximal length	6.5 mm	5.9 mm
Tail segment	44–45%	46.5–51%
Intestinal diverticula	absent	well developed
Anterior teeth	3	4–6
Posterior teeth	0	0
Hooks	11	8–10
Eyes	small	large
Corona ciliata	three cornered shape with regular outline	three lengthened, irregularly shaped processes
Lateral fins	anterior and posterior fins almost rectangular, well separated	anterior fins triangular and posterior ones roundish, in close contact
Position of female genital orifices	lateral, between anterior and posterior fins	ventral, below the junction of anterior and posterior fins
Seminal vesicles	small, crescent shaped	very large, crooked
Adhesive organs	anterior and posterior separated, each with 10–11 free processes	anterior and posterior more or less united, cockscomb shaped

of the genus *Spadella* s. l. have been separated into two groups by Tokioka & Pathansali (1964), and into three other ones by Alvariño (1981a). The latter three were raised to the rank of genus by Salvini-Plawen (1986): *Spadella* s. s. for the species of the *cephaloptera* group, *Gephyrospadella* for those of the *schizoptera* group with one pair of lateral fins, and *Paraspadella* for those of the *schizoptera* group with two pairs of lateral fins. Finally, Bowman & Bieri (1989) combined the last two groups because they did not recognize the existence of two separate pairs of lateral fins, thus minimizing the importance of that characteristic. This proposal agrees with Tokioka and Pathansali's groups, making two genera: *Spadella* and *Paraspadella*, which differ by the absence or presence of adhesive organs.

There are ten known species of *Paraspadella* if, as it is very probable, *P. hummelincki* Alvariño, 1970 is a junior synonym of *P. pulchella* Owre, 1963 (Owre 1973). The following species have only one pair of adhesive organs with finger-like processes: *P. schizoptera* Conant, 1895; *P. johnstoni* Mawson, 1944; *P. pulchella* and *P. nana* Owre, 1963; *P. legazpichessi* Alvariño, 1981b; *P. pimukatharos* Alvariño, 1987; *P.*

coecafera Salvini-Plawen, 1986; and *P. anops* Bowman & Bieri, 1989. Only one species, *P. sheardi* Mawson, 1944, has also two pairs of adhesive organs, but they differ from those of *P. gotoi* since they are well separated and consist of numerous finger-like processes.

The principal characteristics of these species of *Paraspadella* with two pairs of adhesive organs are summarized in Table 1.

Remarks.—*P. gotoi* is the most highly colored chaetognath. The numerous colored pits on the body are reminiscent of *Archeterokrohnia rubra* Casanova, 1986 in which they are localized dorsally in the transverse septum region (unpublished data). The color of its gut also is similar to the bathyal *A. rubra* that is rather unusual in a superficial form, but it must be noted also that orange-brown spots of pigment have been described on the body of *Spadella angulata* (Tokioka & Bieri, 1966) and clusters of reddish cells in the walls of the intestine of *Spadella* (= *Paraspadella*) *pulchella* (Owre 1963), which are both neritic species.

A detailed observation of the adhesive organs of *P. gotoi* shows that they probably have the same origin as fins, the former being modified parts of the latter. Indeed, in

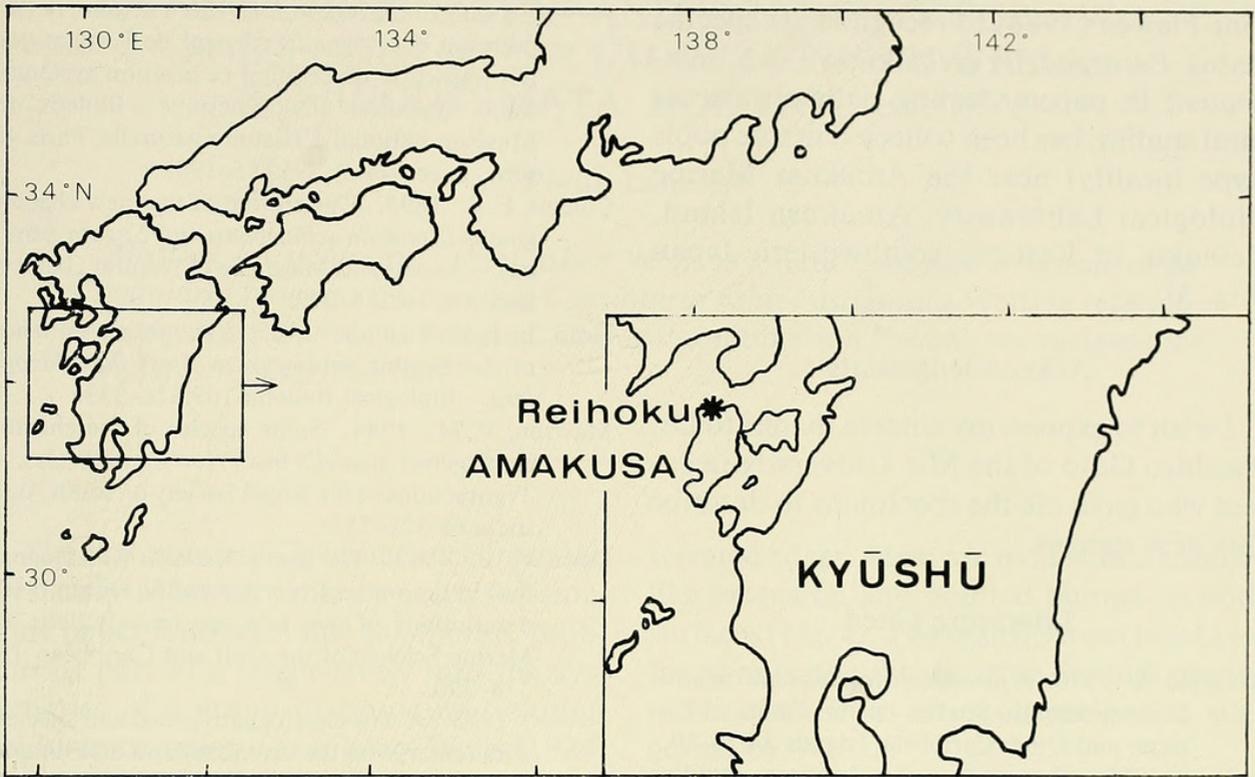


Fig. 3. *Paraspadella gotoi*, n. sp.: Sampling station in Japan (type locality).

one specimen, one finger-like process of the right posterior adhesive organ is fused with the tail fin (Fig. 2a, b). In many others, the posterior edges of both lateral and caudal fins bear tiny papillae as those observed on the extremity of adhesive organs. Lastly, when the collarette tissue is stripped off, these organs appear to be rayed as fins. This is contrary to Mawson's (1944:330) opinion when she wrote: "They [finger-like processes] are therefore not to be regarded as part of the fin," but agrees with previous opinions (Conant 1895, Yosii & Tokioka 1939).

Some morphological features of *P. gotoi* are unique and can be explained by the mating behavior described by Goto & Yoshida (1985). There is cross-fertilization and, when mating, the two partners stand face-to-face. Then, the one that acts as a male jumps and deposits a sperm cluster on the genital orifice of the other, which acts as a female. Thus this orifice is ventral and cannot be dorsal as in all the other chaetognaths but one, *P. sheardi*, where it is exactly lateral,

and the particular shape of the seminal vesicles can help to precisely deposit the sperm. Likewise, the two adhesive organs on each side (one directed forward and the second backwards) allow perhaps the complete erection of the body when mating. In *P. sheardi*, the other species of the genus with two pairs of adhesive organs, the outspread adhesive processes, according to Mawson (1944), serve as "props" to support the body in an almost vertical position. This fact, as with also the lateral opening of oviducts, seems to indicate that the mating behavior is the same as in *P. gotoi*.

Distribution.—Two species of *Paraspadella* are known from the coasts of Japan: *Paraspadella coecafera* was described as *Spadella schizoptera* by Yosii & Tokioka (1939) from a single specimen caught near Misaki, not far from Tokyo, but differs from Conant's description of *Spadella* (= *Paraspadella*) *schizoptera* by the absence of anterior fins and the presence of intestinal diverticula. These reasons recently led Sal-

vini-Plawen (1986) to recognize its specific status. *Paraspadella gotoi*, known as *S. schizoptera* in papers dealing with ultrastructural studies, has been collected in tide pools (type locality) near the Amakusa Marine Biological Laboratory, Amakusa Island, Reihoku, in Kyūshū, southwestern Japan (Fig. 3).

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