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A New Marine Tardigrade, *Batillipes crassipes* sp. nov., from the Japan Sea (Tardigrada Arthrotardigrada, Batillipedidae)

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Abstract: This paper contains the description of a new marine Arthrotardigrada *Batillipes crassipes* sp.nov., living in the sand of the supralittoral zone of Furughelm Island (Peter the Great Bay, Japan Sea). The characteristic features of the new species are: broadened femurs on legs IV, undivided clavae, the location of cirrus E at the level of leg IV and the absence of pairs of smooth lateral projections at this level. Both *B. gilmartini* and *B. pennaki* have a type of legs IV similar to that of *B. crassipes*s, but they have smooth lateral projections of the body at level of legs IV.

Résumé : Cet article décrit une espèce d'arthrotardigrade marin *Batillipes crassipes* sp. nov., provenant des sables de la zone supralittorale de l'île de Furughelm, dans la Baie Pierre le Grand, Mer du Japon. Les traits caractéristiques de la nouvelle espèce sont: les fémurs larges sur les pattes IV, les clavae indivises, l'emplacement du cirre E au niveau de la patte IV et l'absence de renflements latéraux pairs à ce même niveau. *B. gilmartini* et *B. pennaki* ont des pattes IV comparables à celles de *B. crassipes*, mais elles ont des renflements latéraux pairs le long du corps, au niveau des pattes IV.

Keywords: Tardigrada, *Batillipes crassipes* sp. n., taxonomy, Japan Sea, meiofauna

Introduction

Tardigrades from Russian seas are almost unknown with the exception of some brief notes without any comments. Petelina & Tchesunov (1983) reported *Hypsibius appeloefi* Richters, 1908 (more recently transferred to *Halobiotus* by Kristensen, 1982) from the White Sea; they described the White Sea material and made some remarks on individual variation. A second species found in the White Sea and treated in the paper was regarded as *Batillipes* aff. *mirus*. After examining the slides of this latter form, Biserov (1991) found it really do belong to the widespread species *Batillipes mirus* Richters, 1909.

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The genus *Batillipes* was established by Richters (1909) with the type species *B. mirus*, originally described from Kiel Bay in the Baltic Sea. In their monograph on the phylum, Ramazzotti & Maucci (1983) summarized data on variation and provided keys to the recognized 16 species; additional three species were described later (Morone de Lucia *et al.*, 1988, Pollock, 1989).

Identification of species within the genus is presently based on characters such as body shape (e.g. presence or absence of lateral projections), variation in caudal terminations, shape of clava and toe disks, shape of femur of leg IV and its accessory appendages, etc. (McKirdy, 1975; Kristensen, 1978a; Pollock, 1971, 1979; Ramazzotti & Maucci, 1983).

Intraspecific variation during the life cycle has been described in several studies (McGinty & Higgins, 1968,

Grimaldi de Zio & D'Addabbo Gallo, 1975). Fine structure of the cuticle and muscle attachments of *Batillipes noerrevangi* Kristensen, 1976 were examined by Kristensen (1976, 1978b).

In this paper we describe a new species found on Furughelm Island, in the Japan Sea, by the junior author in August 1990.

Material and methods

The tardigrads were found in samples from the upper sandy littoral zone of Furughelm Island, Peter the Great Bay, Japan Sea, in August 1990 (collected by V.O. Mokievsky). All specimens were fixed and stained with acetic carmine, then air dried and embedded in Faure's fluid on microscope slides. The type series are kept in the Zoological Museum of Moscow State University.

Results

Batillipes crassipes sp. nov.
Figures 1-3, Tables 1-2

Type series : 12 adult specimens, 5 of which appear to be males. The type specimens including the holotype and four paratypes (all females) are kept in the Zoological Museum of Moscow State University; the holotype catalogue number is Ic 2-55.

Type locality : The Japan Sea, southern part of Peter the Great Bay, Furughelm Island, upper sandy littoral zone.

Diagnosis : Relatively large (156-248 µm long) *Batillipes*, characterized by 3 or 4 pairs of smooth lateral projections on body, third of which situated at level of legs II. No lateral projections over legs IV, but cirrus E present over base of legs IV. Cephalic appendages, especially median cirrus, short. No cephalic papilla between internal and external cirri. Clava undivided, cylindrical. Femur of legs I-III conical. Femur of legs IV very broad. All legs I-IV with leg spines, the IV spines the shortest. No papillae on legs. Caudal spike small and pointed, with an expanded base.

Description : Measurements of holotype and paratypes are given in Table 1. Cuticle punctate, without distinguishable alae. Body relatively large, nearly rectangular, in females becoming wider posteriorly, with maximum width at level of base of legs III. Head easily distinguishable (Fig. 1).

Body of females with three pairs of small, rounded, easily discernible lateral projections: first pair located behind head and anterior to legs I; second pair at level of posterior edge of legs I; third pair at level of posterior edge of legs II. The lateral projections become less prominent posteriorly. Some females may have a very small fourth pair of projections posterior to legs III.

Greatest width of males is between the I and II legs. In comparison with females, the lateral projections of males are more prominent and the fourth pair is always present at level of posterior edge of leg III.

Table 1. Measurements (µm) of *Batillipes crassipes* sp. nov.
Tableau 1. Dimensions (en µm) de *Batillipes crassipes* sp. nov.

Character	Min-Max (Mean)	Holotype	n
Body length	156-248 (220.0)	244	12
Body width 1 *	60-92 (80.0)	88	12
Body width 2 **	67-112 (91.4)	104	12
Body width 3 ***	66-116 (93.2)	100	12
Lateral cirri	24-40 (31.5)	36	12
Clava	12-16 (13.8)	16	12
External cirri	12-18 (15.0)	16	12
Internal cirri	12-20 (15.8)	20	12
Median cirrus	3-12 (6.7)	6	9
Caudal spine	8-14 (10.4)	8	11
Leg I spine	8-12 (10.3)	12	12
Leg II spine	8-18 (13.7)	14	9
Leg III spine	9-20 (15.3)	16	10
Cirrus E	24-28 (26.0)	24	10
Pharynx	16-28 (22.0)	28	5
Stylet	12-27 (21.8)	?	4

* first lateral projection (anterior to legs I)
** second lateral projection (just posterior to legs I)
*** third lateral projection (just posterior to legs II)
n number of observations

Median cirrus short with sharp point, either extending beyond frontal border of the head or not extending beyond it. Internal cirri each on a short conical base. Length of internal and external cirri nearly equal; there is no papilla between them. Base of external cirrus large, conical, together with base of lateral clava forming a double-summited massive triangular projection on each side of the head (Fig. 1, 2). Clava sticklike, short, smooth, cylindrical, about half as long as lateral cirrus, arising ventrally to the latter on the common base. Lateral cirri about 1.5-2 times as long as both external and internal ones. Body rounded posteriorly, with a short caudal spike resembling a truncate cone on the wide base. Caudal spike barely protruding beyond edge of body. Cirri E relatively long, located over base of legs IV.

Proximal part (femur) of legs I-III conical with dorsal leg spines. Spines either gradually increasing in length from legs I to III, or those of II and III about the same length and always longer than those of legs I. No papillae were found on legs I-III. Spine I is situated on the distal third of the thigh, spines II and III are closer to the proximal part.

Femur IV very broad, with two round asymmetrical projections on distal end, making contour of thigh nearly rectangular. Dorsal leg spine IV is shorter than those of legs I - III. No papillae on legs IV.

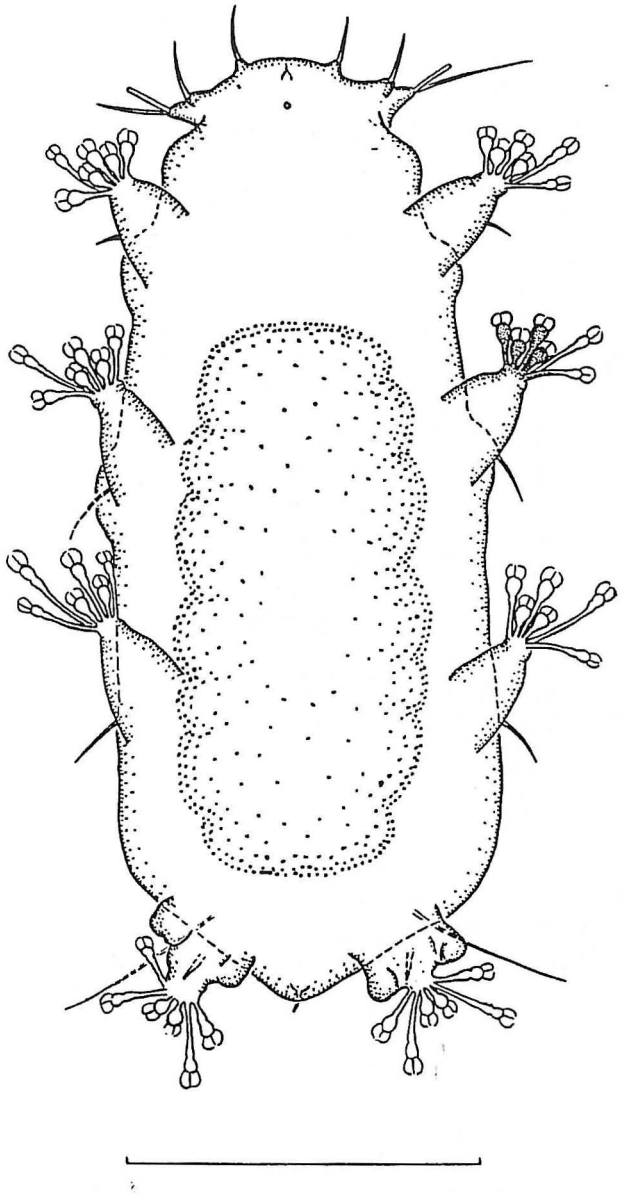

Figure 1. *Batillipes crassipes* sp.nov., holotype, female, ventral view. Scale bar = 100 µm.

Figure 1. *Batillipes crassipes* sp.nov., holotype, femelle, vue ventrale. Echelle = 100 µm.

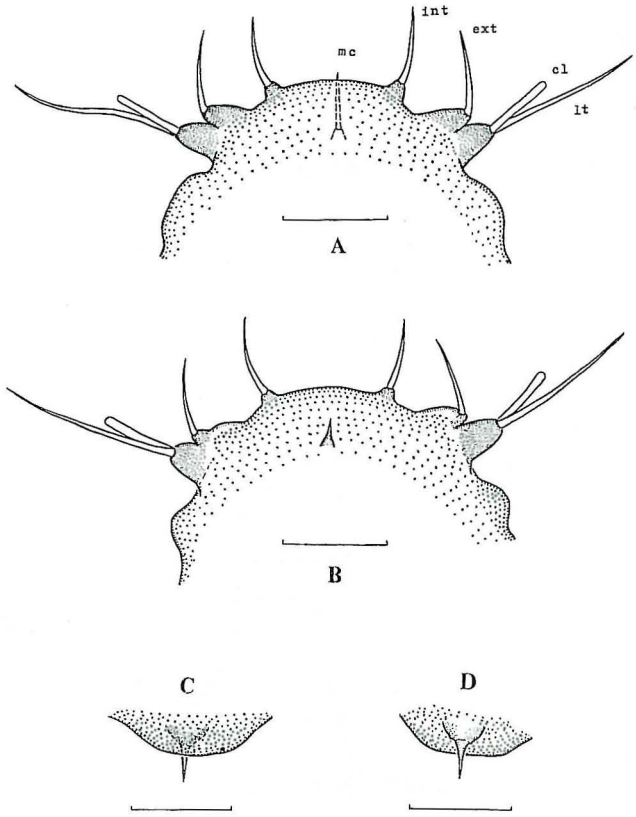

Figure 2. *Batillipes crassipes* sp.nov., paratypes, females. A: anterior end of body, ventral view; B: anterior end of body, dorsal view; C: caudal spine, ventral view; D: same as C, dorsal view.

Scale bars = 20 µm. cl = clava, ext = external cirrus, int = internal cirrus, lt = lateral cirrus, mc = median cirrus.

Figure 2. *Batillipes crassipes* sp.nov., paratypes, femelles. A : région antérieure du corps, vue ventrale ; B : région antérieure du corps, vue dorsale C : épine caudale, vue ventrale ; D : comme C, vue dorsale.

Echelles = 20 µm. cl = clava, ext = cirre externe, int = cirre interne, lt = cirre latéral, mc = cirre médian.

Toes with round terminal discs as wide as, or bigger than, width of distal inflation of toe; discs with median ridges. Measurements of toes 1-6 on legs I-IV given in Table 2. In all cases, toe 5 is clearly the longest in the first three pairs of legs. On legs I-III, toes 2 and 4 are similar and shortest; toes 1, 3 and 6 are similar and about twice as long as toes 2 and 4 (Fig. 3, A-C). On leg IV, toes 3 and 4 are nearly equal and shortest; toes 2 and 6 are intermediate; toes 1 and 5 are roughly 2-3 times as long as toes 3 and 4 (Fig.3, D).

Discussion

The most recent keys to 16 of the 19 presently described species of *Batillipes* are provided by Pollock (1979) and Ramazzotti & Maucci (1983).

One of the most remarkable peculiarities of *Batillipes crassipes* is the very broad femurs of legs IV. Only *B. gilmartini* McGinty, 1969 and *B. pennaki* Marcus, 1946 have a similar type of legs IV (McGinty, 1969, Marcus, 1946). However, the new species has, unlike *B. gilmartini*, a pointed caudal spike, rather than a blunt-tipped conical one; there are no projections of the body at the level of legs IV and the clavae are cylindrical and undivided.

B. crassipes has more features in common with *B. pennaki*, but is easily distinguished from it by the undivided clavae,

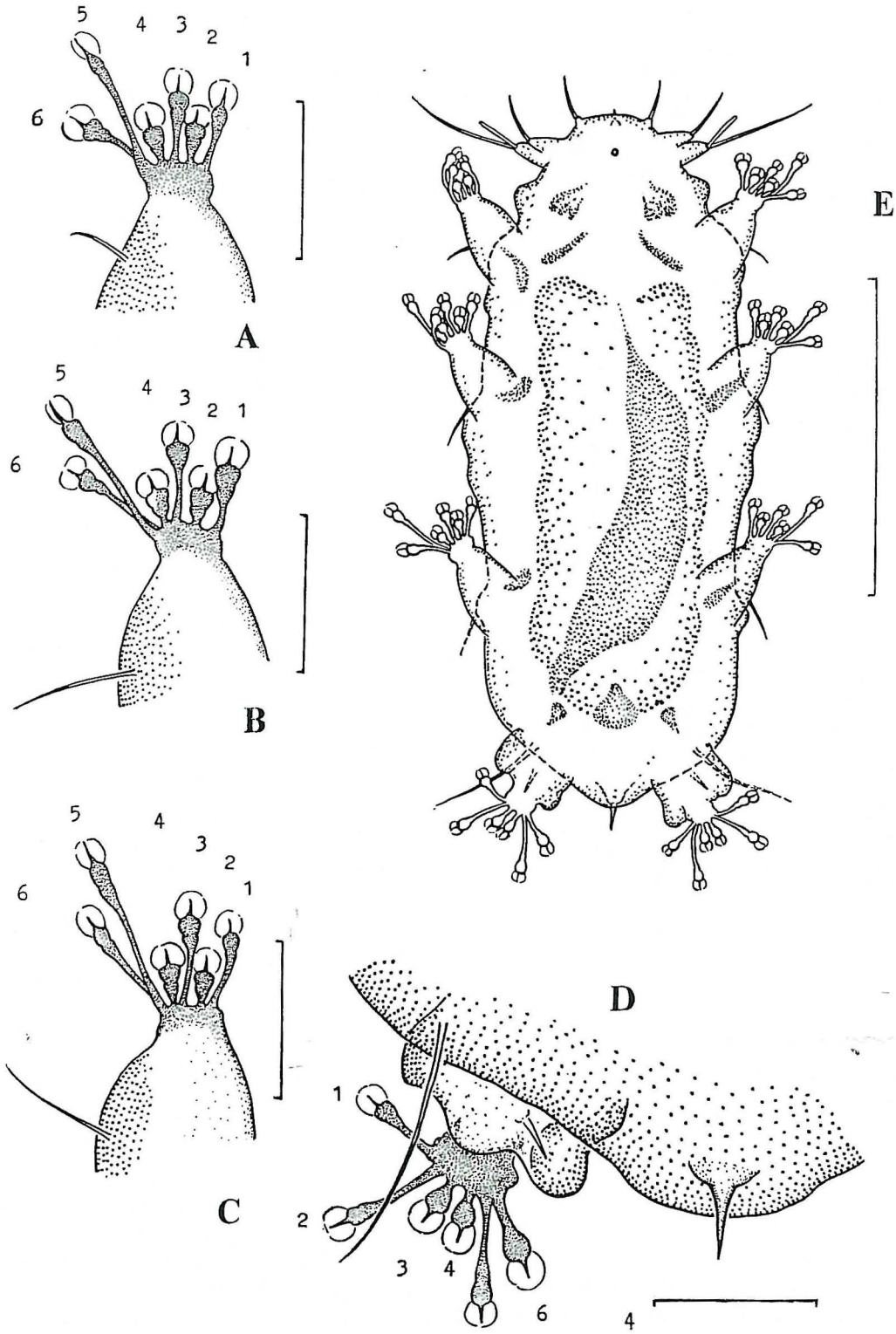

Figure 3. *Batillipes crassipes* sp.nov., paratypes. A-D: legs of female, left side, dorsal view, toes 1 - 6 numbered; (D: with adjacent part of body, cirrus E and caudal spike); E: male, ventral view. Scale bars A-D = 20 µm, E = 100 µm.

Figure 3. *Batillipes crassipes* sp.nov., paratypes. A-D : pattes d'une femelle côté gauche, vue dorsale, orteils 1 - 6 numérotés ; (D : avec la partie adjacente du corps, le cirre E et l'épine caudale) ; E : mâle, vue ventrale. Echelles : A-D = 20 µm, E = 100 µm.

and less prominent lateral projections of the body. *B. pennaki* also has more than three pairs of such projections and the posterior ones, situated anterior to the bases of legs IV, are the best developed. In *B. crassipes*, the fourth pair of projections is usually absent in females and small in males.

Ecological notes. The biotope of *B. crassipes* is the medium-sized sand (0.25 - 0.5 mm in diameter) of the supralittoral zone of Furughelm Island, about 15-20 cm above high tide level. The species inhabits a narrow strip of the sandy beach, penetrating to a depth of about 60-80 cm into the sediment. The maximum density, 15-20 individuals per square cm is in the uppermost dry level of sand.

Remark. McKirdy (1975) reviewed and evaluated the characters of species of *Batillipes*, in particular the morphology of the palm and toes. The form of the terminal discs (either round, lancetiform or rectangular; either wider or narrower than distal extension of toes) was suggested to be a useful character. However, the relative lengths of the toes are of no less significance. Toes do not contract, and according to our data (Table 2), their relative lengths do not show individual variation. The relative lengths are the same for legs I-III and different for legs IV. If the shortest toes are considered to be equal to 1, an approximate ratio between their lengths, from toe 1 to toe 6, may be expressed for legs I - III as: 2:1:2:1:3.5:2 and for leg IV as: 2:2.5:1:1:3:1.5. We agree with Pollock (1970), who was the first to notice this feature and to suggest that it should be included in descriptions of the species.

Table 2. *Batillipes crassipes* sp. nov. Length (µm) of toes (min-max (mean)) on left side of body, 12 observations.

Tableau 2. *Batillipes crassipes* sp. nov. Longueur (en µm) des orteils (min-max (moyenne)) sur la partie gauche du corps, 12 observations.

Toe	Leg I	Leg II	Leg III	Leg IV
1	8.8-12.8 (10.3)	8.8-12 (10.6)	9-13.6 (10.7)	9.6-16 (12.3)
2	4.8-6.4 (5.6)	4.8-6.4 (5.6)	4.8-5.6 (5.4)	12.8-19 (15.3)
3	8.8-12 (10.5)	8.8-12.8 (11.3)	9.6-14.4 (12)	4-7.2 (5.7)
4	4.8-6.4 (5.6)	4.8-6.4 (5.6)	4.8-8.8 (5.8)	4-7.2 (5.7)
5	12-21.6 (18.3)	16-24.8 (21.6)	13.6-27 (21.7)	12-20.8 (17)
6	8-12.8 (11.1)	9.6-17.6 (12.1)	9.6-16.8 (13)	6.4-13.6 (10)

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