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A NEW SPECIES OF *TESTUDINELLA* (ROTIFERA: TESTUDINELLIDAE) FROM QI'AO ISLAND, PEARL RIVER ESTUARY, CHINA

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A new species of rotifer, *Testudinella zhujiangensis* sp. n. (Rotifera, Monogononta, Testudinellidae), is described from the littoral of an artificial brackish water lake and a mangrove swamp on Qi'ao Island of the Zhujiang/Pearl River estuary, Guangdong Province, south of China. It is closely related to *Testudinella obscura* ALTHAUS, 1957, but distinguished by its anterior truncated vase-shaped lorica, cross-sectional view, shallow inverted U-shaped foot opening, and small differences in the morphology of the trophi.

Key words: Rotifera, *Testudinella*, new species, brackish water, China

INTRODUCTION

The most species-rich genus *Testudinella* BORY DE ST. VINCENT, 1826 of the family Testudinellidae (Rotifera, Monogononta) comprises more than 40 species considered valid in the recent annotated checklist of rotifers by SEGERS (2007). They live mainly in benthic-periphytic and interstitial habitats, and most of them inhabit the littoral of freshwater lakes and ponds. Eleven of them have been found in salt waters. Only five, *Testudinella bicorniculata* DE SMET, 2009, *T. clypeata* (MÜLLER, 1786), *T. dentata* MYERS, 1934, *T. elongata* DE SMET, 2009 and *T. obscura* ALTHAUS, 1957 are strictly haline, living in marine and/or brackish waters. The others are haloxenous (*T. elliptica* (EHRENBERG, 1834), *T. truncata* (GOSSE, 1886)) or euryhaline (*T. crassa* (LEVANDER, 1894) sp. inq., *T. incisa* (TERNETZ, 1892), *T. patina* (HERMANN, 1783), *T. reflexa* (GOSSE, 1887)) (DE SMET 2009, FONTANETO *et al*. 2006, 2008).

To date only 11 species and subspecies have been reported from China. With the exception of *Testudinella magna* GONG, 1983 which appears endemic (ZHUGE *et al*. 1998), all others are widely distributed or cosmopolitan and collected from inland freshwaters only. In this contribution, a hitherto unknown brackish water species, *Testudinella zhujiangensis* sp. n., is described from Qi'ao Island of the Zhuijang/Pearl River estuary, China.

MATERIALS AND METHODS

Littoral plankton samples of an artificial lake and a mangrove swamp near this lake on Qi'ao Island of the Zhuijang/Pearl River estuary, Guangdong province, south of China (Fig. 1) were collected with a 2.5 L plastic water sampler, and preserved in 4% formalin. Both localities were sampled monthly in 2007. Rotifer specimens were selected under a Shunyu SZ stereo-microscope and examined with a Nikon E800 microscope. Drawings were made using a camera lucida. The trophi of the specimens were prepared for scanning electron microscopy (SEM) using sodium hypochlorite following the procedure described in DE SMET (1998). SEM was performed with a Philips SEM-515 microscope operated at 20 kV.

DESCRIPTION OF THE NEW SPECIES

Testudinella zhujiangensis sp. n.
(Figs 2–4)

Type locality – An artificial lake of Qi'ao – Dangan provincial mangrove nature reserve on Qi'ao Island (22°26'N, 113°38'E), Zhuhai, Guangdong Province, China.

Holotype – A female in a permanent, glycerine glass slide mount deposited in the Biology Museum of Sun Yat-sen University, Guangdong, China (ROT00004).

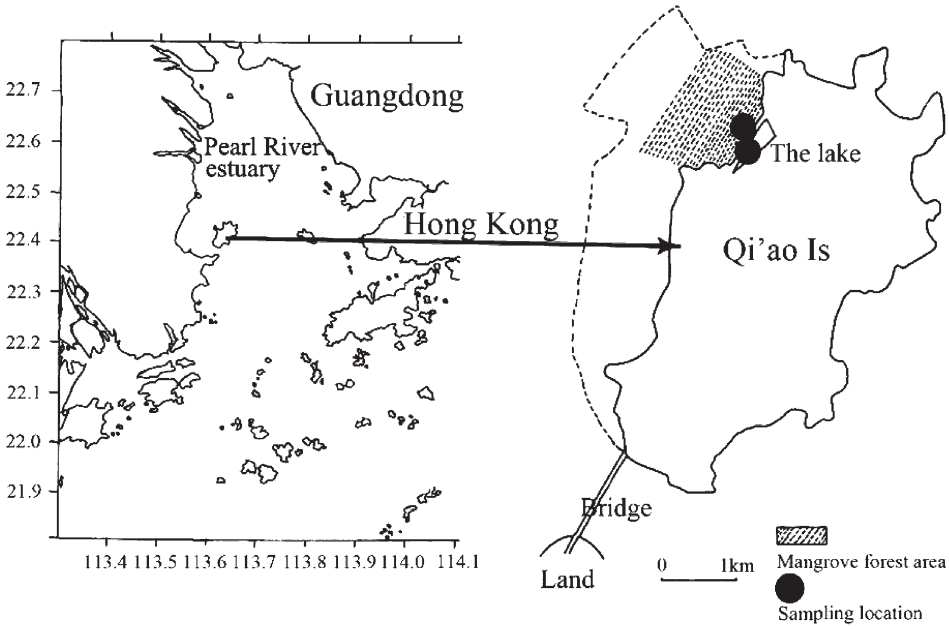

Fig. 1. Location of the sampling sites on Qi'ao Island of the Zhujiang/Pearl River estuary, Guangdong, China. Shadow area stands for mangrove forest; black circles represent the sampling locations

Paratypes – Two females in Biology Museum of Sun Yat-sen University (ROT00005, ROT 00006); 3 females in the Academy of Natural Sciences of Philadelphia (ANSP 2074) and one in the Royal Belgian Institute of Natural Sciences (RBINS), Brussels, Belgium (No. IG. 31542, RIR 201).

Etymology – The name of the new species is derived from Zhujiang, the Chinese name of the Pearl River, referring to the estuary the type locality is situated in.

Diagnosis – *Testudinella zhujiangensis* sp. n. is characterized by: a vase-shaped, anteriorly truncated lorica; dorsal anterior margin with broad flat median part and almost straight or weakly undulate lateral parts; ventral anterior margin with shallow median sinus bordered laterally by straight or weakly curved edges; cross-sectional view cruciform with broadly rounded lateral edges; foot opening sub-terminal, a shallow inverted U-shaped slit; distal foot pseudosegment moderately long, penultimate one shorter; unci teeth with lanceolate head; head of major teeth of similar dimension and shape; webbing of minor teeth almost extending up to heads.

Description of female – The lorica (Fig. 2) is vase-shaped, truncate anteriorly, smooth or occasionally very weakly striated (Fig. 2A). The ratio lorica length/lorica width is 1.49–1.67 (average 1.57). The dorsal anterior margin shows a broad, flat median part connected by straight or weakly undulate lateral parts. The ventral margin shows a shallow median sinus, bordered laterally by straight (Fig. 2A, B) or weakly curved (Fig. 2C–E) edges. The dorsal anterior margin not or just reaches (Fig. 2F) the ventral margin. The posterior margin is smoothly rounded or very weakly rounded-angular (Fig. 2F), or shows an inconspicuous rounded projection (Fig. 2B). In cross-sectional view (Fig. 2G) the body appears more or less cruciform by the presence of two longitudinal dorsal and ventral furrows, delimiting a protruding median part and broadly rounded lateral edges. The foot opening is sub-terminal, on the ventral side; it takes the shape of a shallow inverted U-shaped slit widening distally. The foot is composed of a long wrinkled proximal part, a short slender penultimate and a longer distal pseudosegment ending in a ciliated cup (Fig. 2H). The ratio lorica length/position of antennae relative to the antero-dorsal margin averages 2.30 (2.14–2.57) for the lateral antennae and 3.00 (2.76–3.06) for the dorsal antenna. Two red eyespots.

Trophi malleoramate (Figs 3, 4). The rami (Fig. 3A: r) are elongate-triangular with rounded latero-ventral margins, delimiting large latero-ventral fenestrae (Fig. 3B: rf). The frontal ones of the latero-ventral margins bear a short and blunt, caudally recurved alula (Fig. 3B: al). Median rami apophyses (Fig. 3B: ra) are weakly developed. The inner margins of the distal rami sections caudally show 14–16/15–17 (left/right) arched and webbed rami scleropili (Fig. 3B: as). Basal apophyses form moderately developed ridges, composed of partially fused scleropili (Fig. 4: ba). The fulcrum (Fig. 3A: f) is short and plank-shaped, composed of a double layer of long and longitudinally oriented sclerite bodies, with obvious proximal opening frontally (Fig. 4: fo). The unci plates (Fig. 3A: u) consist of 10–12/9–12 (left/right) weakly curved and strongly webbed teeth. Each uncus has 3, occasionally 4, major teeth with moderately offset lanceolate heads of almost similar dimension. The minor teeth have a lanceolate head bearing two minute lateral knobs at their base; the webbing almost extends up to the base of the heads. The crescent-shaped manubria are composed of a superimposed dorsal, median, ventral and small sub-ventral chamber (Fig. 3B: dc, mc, vc, svc).

Male and eggs unknown.

Measurements – Lorica length 120–127 µm (mean = 123 µm, N = 10), lorica width 74–82 µm (mean = 78 µm, N = 10), anterior aperture width 49–53 µm (mean = 51 µm, N = 10), penultimate foot pseudosegment 4–5 µm (mean = 4 µm, N = 4), distal foot pseudosegment 14–15 µm (mean = 14, N = 4); trophi (N = 5): length × width 17.0–20.0 × 22.5–26.0 µm, ramus 10.0–12.5 µm, fulcrum 6.0–8.5 µm, largest major tooth 10.0–12.0 µm, manubrium 8.5–12.0 µm.

Distribution and ecology – The species was to date only collected from the littoral plankton of an artificial lake at depths of about 50 cm and distances from the shore of about 2 m, as well as from a mangrove swamp near this lake on Qi'ao

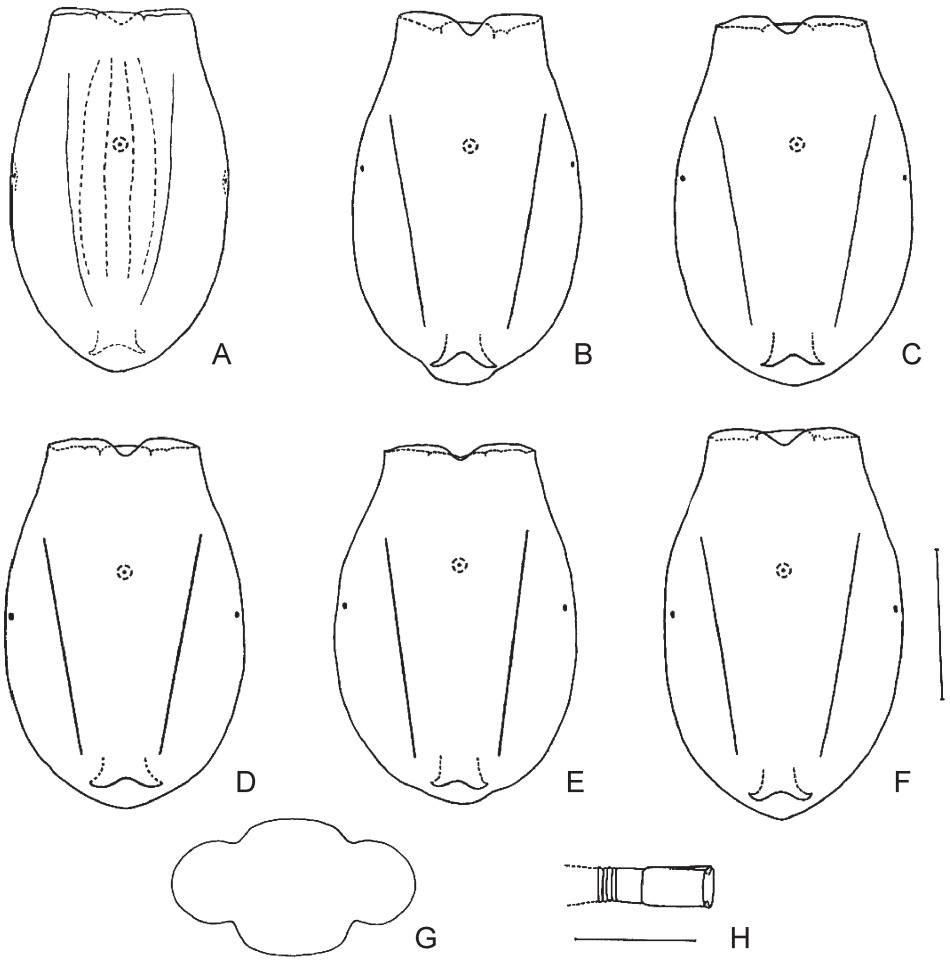

Fig. 2. *Testudinella zhujiangensis* sp. n.: A. Lorica, dorsal view. B–F. Lorica, ventral view. G. Lorica, cross-sectional view. H. Foot pseudosegments. Scale bars: A–G: 50 µm, H: 25 µm

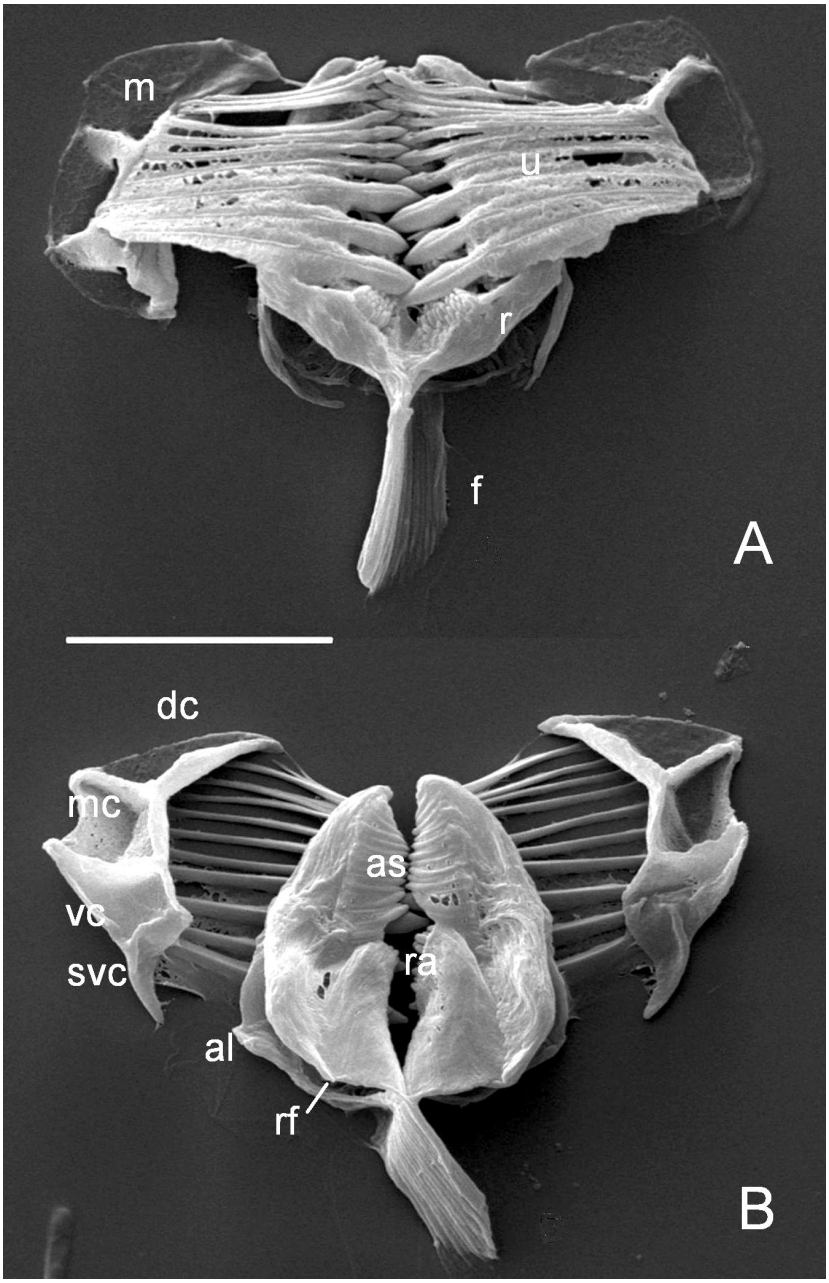

Fig. 3. *Testudinella zhujiangensis* sp. n., scanning electron microscope photographs of trophi. A. Frontal view. B. Caudal view. Scale bar: 10 μm. al: alula, as: arched scleropili, dc: dorsal chamber, f: fulcrum, m: manubrium, mc: median chamber, r: ramus, ra: ramus apophysis, rf: ramus fenestra, svc: sub-ventral chamber, u: uncus, vc: ventral chamber

Island of the Pearl River estuary. Its occurrence was restricted to January and April in the lake, and March, August, September, November and December in the swamp. The highest densities were noted in April for the lake (up to 100 individuals L^{-1}) and December for the swamp (72 individuals L^{-1}). Water depth of the littoral zone of the lake comes to 1 m and the wet depth of the mangrove swamp is about 30 cm. Water temperatures varied from 14–30 °C, salinity varied from 10–22‰.

DISCUSSION

The presence of a proximal fulcrum opening suggests that *Testudinella zhujiangensis* sp. n. forms a monophylum with *T. bicorniculata*, *T. clypeata*, *T. elongata* and *T. obscura*. Besides this fulcrum opening, the group shares a slit-like foot opening and a brackish and/or marine habitat. Of all it congeners, *T. zhujiangensis* sp. n. resembles and is probably most closely related to *T. obscura*. The spe-

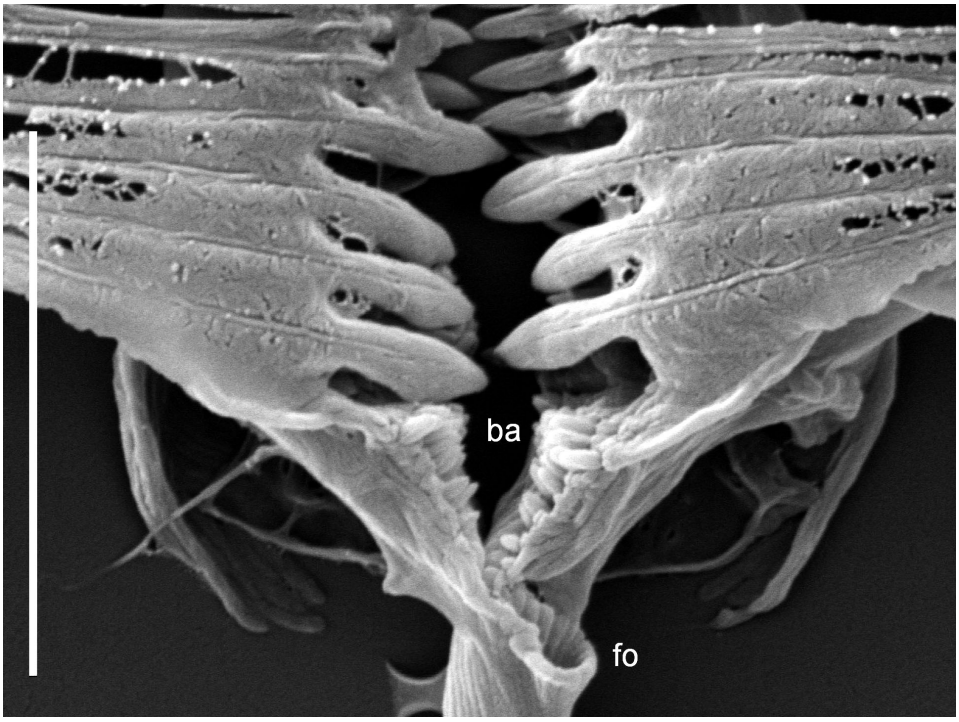

Fig. 4. *Testudinella zhujiangensis* sp. n., scanning electron microscope photograph of trophi. Detail of major teeth and proximal part of fulcrum, frontal view. Scale bar: 10 µm. ba: basal apophysis, fo: fulcrum opening

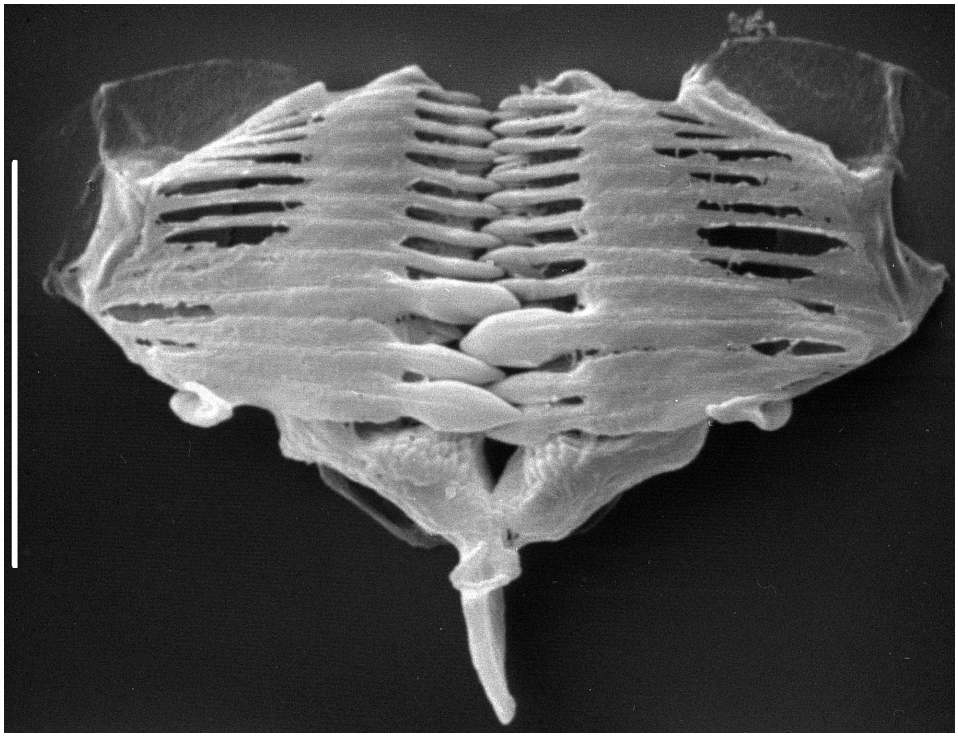

Fig. 5. *Testudinella obscura*, scanning electron microscope photograph of trophi, frontal view. Scale bar: 10 μm. Origin: Mediterranean, Bay of Hyères, France

cies differs mostly by its vase-shaped and distinctly truncate lorica, distinguishable from the more or less elliptical and anteriorly weakly truncate lorica in *T. obscura*, and the cross-section of the body showing 4 rounded lobes instead of the dorsally arched and ventrally flattened body edges in *T. obscura*. Also the split-shaped foot opening appears wider and placed more distally in the new species. Small differences are also apparent in the ratio lorica length/postion of antennae relative to the antero-dorsal margin: for the dorsal antenna the ratio averages 3.0 (2.8–3.1) and 2.6 (2.4–2.9) in *T. zhujiangensis* sp. n. and *T. obscura*, respectively, for the lateral antennae these ratios are 2.3 (2.1–2.6) and 2.1 (2.0–2.2). Additional differences in trophi structure concern the shape of the unci plates showing weakly curved teeth with lanceolate heads, the heads of the major teeth having almost similar dimensions, and the webbing of the minor teeth almost extending up to the base of the heads in *T. zhujiangensis* sp. n., whereas in *T. obscura* (Fig. 4) teeth are straight, the heads of the major teeth show different shapes and dimensions, and the less offset heads of the minor teeth are cylindrical to elongate-lanceolate with the webbing not extending up to the base forming a rake-like structure. Superficially, *T.*

zhujiangensis sp. n. resembles *T. bicorniculata* and *T. truncata* which both have a vase-shaped lorica as well. It is easily differentiated from *T. bicorniculata* by the absence of acute antero-lateral projections and the undulate dorsal and ventral margins with shallow median sinus shown by the latter. It can be distinguished from *T. truncata* by the absence of acute antero-lateral corners, the subterminal inverted U-shaped foot opening (foot opening terminal and more or less rectangular in *T. truncata*), the presence of a sub-ventral manubrium chamber and proximal fulcrum opening (both absent in *T. truncata* (DE SMET 2005)), more slender and weakly offset heads of major unci teeth, and a smaller number of arched scleropili (14–16/15–17 vs ~22/25 in *T. truncata* (DE SMET 2005)).

Rotifers, as a result of adaptations to different food sources, display great differences in anatomy and functioning of the mastax and its contained trophi. The malleoramate trophi of Testudinellidae are characteristic for micro-feeders and apparently particularly adapted for grinding bacteria, particulate detritus, small diatoms etc. Interspecific trophi differences are supposed to reflect differences in the type of food eaten by the different species (e.g. SALT *et al.* 1978, SEGERS 1997). The differences between the new species and its close relative *T. obscura* in trophi morphology, especially the peculiar rake-like configuration of the minor unci teeth in the latter, evidence different feeding habits as well. Unfortunately, it was impossible to identify the gut contents of both species.

The new species may be more widespread and mistaken for *T. obscura*. The latter appears a typical inhabitant of marine sub-tidal psammon (DE SMET 2009), and the single undocumented report by GREEN (1995) from plankton of the brackish Chukai river estuary opening in the South China Sea, Malaysia, may concern *T. zhujiangensis* sp. n. as well.

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