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The genus *Mytilina* in China, with description of a new species (Rotifera: Monogononta: Mytilinidae)

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Abstract

During our study of biodiversity of Rotifera in PR China, as model taxon of freshwater Micrometazoa, we came across several records that warrant revision regarding species of genus *Mytilina* Bory de St. Vincent, 1826 (Rotifera, Monogononta, Mytilinidae). In addition to this review we describe a new species encountered during examination of freshwater habitats of Inner Mongolia, P.R.China. This new species, *Mytilina wangi* n. sp., appears to belong to the *Mytilina mucronata* - *ventralis* complex but differs from the known taxa in the group by its domed lorica and relatively short toes. We provide an annotated checklist of the Chinese representatives of the genus and discuss the species of the *M. mucronata*-*ventralis* group. We suggest treating *M. brevispina* (Ehrenberg, 1830) and *M. ventralis* (Ehrenberg, 1830) (synonym: *M. macracantha* (Gosse, 1886)) as separate species-level taxa rather than as two infrasubspecific variants of the same species, and argue that *Mytilina trigona* var. *bispinosa* Wang, 1961 is a misidentified *M. acanthophora* Hauer, 1938 rather than an infrasubspecific variant of *M. trigona* (Gosse, 1851).

Key words: biodiversity, biogeography, micrometazoa, taxonomy

Introduction

Information on biodiversity and chorology of freshwater micrometazoans of the Eastern Palearctic is quite scarce when compared to the Western Palearctic. This holds in particular for Rotifera, as representative taxon of Micrometazoa that are main constituents of freshwater ecosystems, in PR China (see Fontaneto *et al.* 2012). Most existing records of Chinese representatives of this crucial zooplankton group are quite old and based on outdated taxonomy (Wang 1958; 1961; Gong 1983), notwithstanding that a number of reports have recently become available (Koste & Zhuge 1996; 1998; Luo *et al.* 2012; Segers & Wang 1997; Segers & Su 1998; Zhuge & Huang 1997; Zhuge *et al.* 1998), including works involving molecular techniques (e.g., Xiang *et al.* 2010) and works involving rotifers in ecological research (e.g., Wen *et al.* 2011). A re-examination of available records is therefore needed to produce a solid basis for future comprehensive work on biodiversity of the taxon in PR China.

Being aware that a recent review of the Mongolian rotifers (Jersabek & Bolortsetseg 2010) indicated a relatively rich fauna including several potentially new, as yet undescribed species for the region, the College of Life and Environment of Shanghai Normal University performed, in July 2013, a sampling campaign of swamps in prairies and forests of Inner Mongolia as a first step towards addressing the dearth of information on this group of organisms. These samples are now being processed, but the discovery of a new species of *Mytilina* prompted a review of the Chinese representatives of this genus.

Genus *Mytilina* Bory de St. Vincent 1826 contains relatively few representatives in the Palearctic region. Of about 20 extant species-level taxa, 12 have been recorded from the Palearctic (Segers 2007), while Zhuge *et al.* (1998) record nine taxa including an endemic subspecies; Sudzuki & Huang (1997) describe one additional Chinese *Mytilina*. Species of *Mytilina* are loricate, have malleate trophi, and a pseudosegmented foot bearing two toes. They are further characterized by their lorica consisting of two lateral or three lateral and one ventral plate. The plates are fused ventrally or ventro-laterally but leave a characteristic dorsal sulcus. The genus is mostly

separated into two groups according to the stiffness of their lorica (Koste & Shiel 1989). The first group, which contains the commonest species of the genus (*M. mucronata* (Müller, 1773) and *Mytilina ventralis* (Ehrenberg, 1830)), has a relatively stiff lorica, is usually provided with anterior and/or posterior spines, and is characterised by the anterior margin of the lorica being granulated and forming some collar-like structure around the head aperture. The second group has relatively soft lorica, and lacks caudal lorica spines. Lorica of these species is mostly transparent, and the anterior margin of the lorica does not have a differentiated collar. The distribution of *Mytilina* species is rather poorly known, due to frequent misidentifications. Most taxa, except a few that have been recorded only once or twice, are widespread and cosmopolitan.

Material and methods

Samples were collected by performing horizontal and oblique hauls using a standard plankton net (mesh width 50 µm) at a depth of about 0.5 m focussing especially at littoral areas. Material was preserved immediately in 4% formalin. Individual rotifers were separated under an Olympus SZX16 dissection microscope and examined and measured using a compound microscope (Olympus BX53) at high magnification using a micrometer eyepiece. Drawings were made using a camera lucida. Photographs were taken by a camera (Olympus DP73) connected to the microscope. Materials are deposited in the Royal Belgian Institute of Natural Sciences (RBINS) and Shanghai Normal University (SHNU).

To identify *Mytilina* species, we found the key by Koste and Shiel (1989) and the discussion in Pourriot (1996) most useful. The work of Koste (1978), in particular the plates, were also helpful.

Results and discussion

Table 1 gives a checklist of the species of *Mytilina* recorded from PR China to date. The record includes two purportedly endemic taxa of (infra)subspecific rank in the Chinese fauna. Of these, *Mytilina trigona* var. *bispinosa* Wang, 1961 (listed as of subspecific rank by Zhuge et al. 1998), is unrelated to *Mytilina trigona*. The original figure by Wang (1961) quite unmistakably depicts a *Mytilina acanthophora* Hauer, 1938 rather than a variant of *M. trigona* (Gosse, 1851). In particular, the triangular projection on the ventral head aperture, presence of deep invaginations laterally of the foot aperture, and broad dorsal sulcus is as in *M. acanthophora*, unlike in *M. trigona*. The lorica is stippled in both *M. acanthophora* and *M. trigona*. While the unique record of the warm-water *M. acanthophora* at the latitude of Wuhan in PR China is remarkable and would benefit from confirmation, the presence of *Mytilina trigona* in China, on the other hand, is confirmed by a record included in the doctoral thesis of Y. Zhuge (1997, cited in Zhuge et al. 1998). According to Jersabek & Leitner (2013), the status of the second endemic Chinese *Mytilina*, *Mytilina ventralis wuhanensis* Sudzuki & Huang, 1997 requires confirmation. Nevertheless, albeit that description of the taxon is summary, it does include a number of features that preclude it being discarded as potentially invalid.

TABLE 1. Checklist of the Chinese *Mytilina* Bory de St Vincent, 1826
Taxa that to date only have been recorded from China are indicated with an asterisk.

<i>Mytilina acanthophora</i> Hauer, 1938
sub. * <i>Mytilina trigona</i> var. <i>bispinosa</i> Wang, 1961
<i>Mytilina bisulcata</i> (Lucks, 1912)
<i>Mytilina brevispina</i> (Ehrenberg, 1830) (sub. <i>M. ventripes brevispina</i> in Zhuge et al. (1998) (lapsus))
<i>Mytilina compressa</i> (Gosse, 1851)
<i>Mytilina mucronata mucronata</i> (Müller, 1773)
<i>Mytilina mucronata spinigera</i> (Ehrenberg, 1830)
<i>Mytilina trigona</i> (Gosse, 1851)
<i>Mytilina ventralis</i> (Ehrenberg, 1830) (sub. <i>M. ventripes</i> and <i>M. ventripes macracantha</i> in Zhuge et al. (1998) (lapsus))
* <i>Mytilina ventralis wuhanensis</i> Sudzuki & Huang, 1997 (<i>species inquirenda?</i>)
* <i>Mytilina wangi</i> n. sp.

In a recent study using DNA barcodes, Garcia-Morales & Gutierrez (2013) showed that the levels of COI divergence between strains of what they identified as *M. ventralis* var. *brevispina* and *M. ventralis* var. *macracantha* reached a mean of 21.70%; they identified four genetic clusters in *M. ventralis* var. *macracantha*, with mean divergence of 20.19%. This large genetic difference indicates that the taxon may be a complex of cryptic species. In the light of the above, the identity and status of a number of synonyms or of (infra)subspecific taxa in *Mytilina* (e.g., *M. cortina* (Thorpe, 1891), *M. mucronata spinigera* (Ehrenberg, 1830), *M. mucronata longicauda* Dartnall & Hollowday (1985), and *M. ventralis* f. *longidactyla* Wulfert, 1965) may need to be reconsidered. Indeed, recent studies have questioned the appurtenance of some of these variants to their respective nominal taxa. The case of *Mytilina michelangelii* Reid & Turner, 1988 is illustrative: the animal was originally described as a variant of *M. ventralis*, but later recognized as separate taxon at subspecies (Reid & Turner 1988) or species level (Pourriot 1996), and is now established as a widespread tropical species, occurring in South America, Africa, and the Oriental region (Segers 1997; Sa-aridrit *et al.* 2013). A similar situation may be the case for the animal depicted as *M. ventralis macrantha* in Koste (1972: plate 6 Fig. 2, also Koste & Shiel 1989: Fig. 11:4) or as *M. mucronata* var. *spinigera* in Koste (1978: plate 42 Fig. 7): this South American animal deviates significantly from long-spined *M. mucronata* and *M. ventralis* in the shape of the antero-dorsal spines (short, rounded in Koste, 1972; elongate, sharp in *M. mucronata spinigera*) and general lorica shape, and may well represent an as yet unnamed species

Most authors follow Koste (1978) in referring to the short-spined taxon illustrated in Figure 9 as *M. ventralis* or *M. ventralis* var. *brevispina*, or this latter name at any other rank, while the long-spined animal (Fig. 10) is commonly referred to as *M. ventralis macracantha*. The original description of *M. ventralis* as well as that of *M. macracantha*, however, both depict a long-spined specimen (Ehrenberg 1830; Gosse *in* Hudson & Gosse 1886; see Jersabek & Leitner, 2013), so these names must be considered subjective synonyms under the present understanding. There are no arguments in favour of dealing with the occasionally co-occurring *M. ventralis* and *M. brevispina* as subspecies, apart of superficial morphological similarity, and it should be noted that there are more morphological differences between the two than spine length (e.g., position and shape of ventral spines, relative length of lorica, shape of foot aperture: compare Figs 9 and 10). In view, moreover, of the results of the above-mentioned studies using molecular tools, we suggest treating the two taxa as separate species. The senior, available name for the short-spined animal is therefore *M. brevispina*, the one for the long-spined animal is *M. ventralis*.

During our study of rotifers from Inner Mongolia, we found representatives of a previously unknown species, which we describe as follows. The cases treated above and the new species described herein clearly demonstrate that the taxonomic complexity of the group has been underestimated and its biodiversity and distribution are in dire need of revision.

Phylum Rotifera Cuvier, 1817

Class Eurotatoria De Ridder, 1957

Subclass Monogononta Plate, 1889

Order Ploima Hudson & Gosse, 1886

Family Mytilinidae Haring, 1913

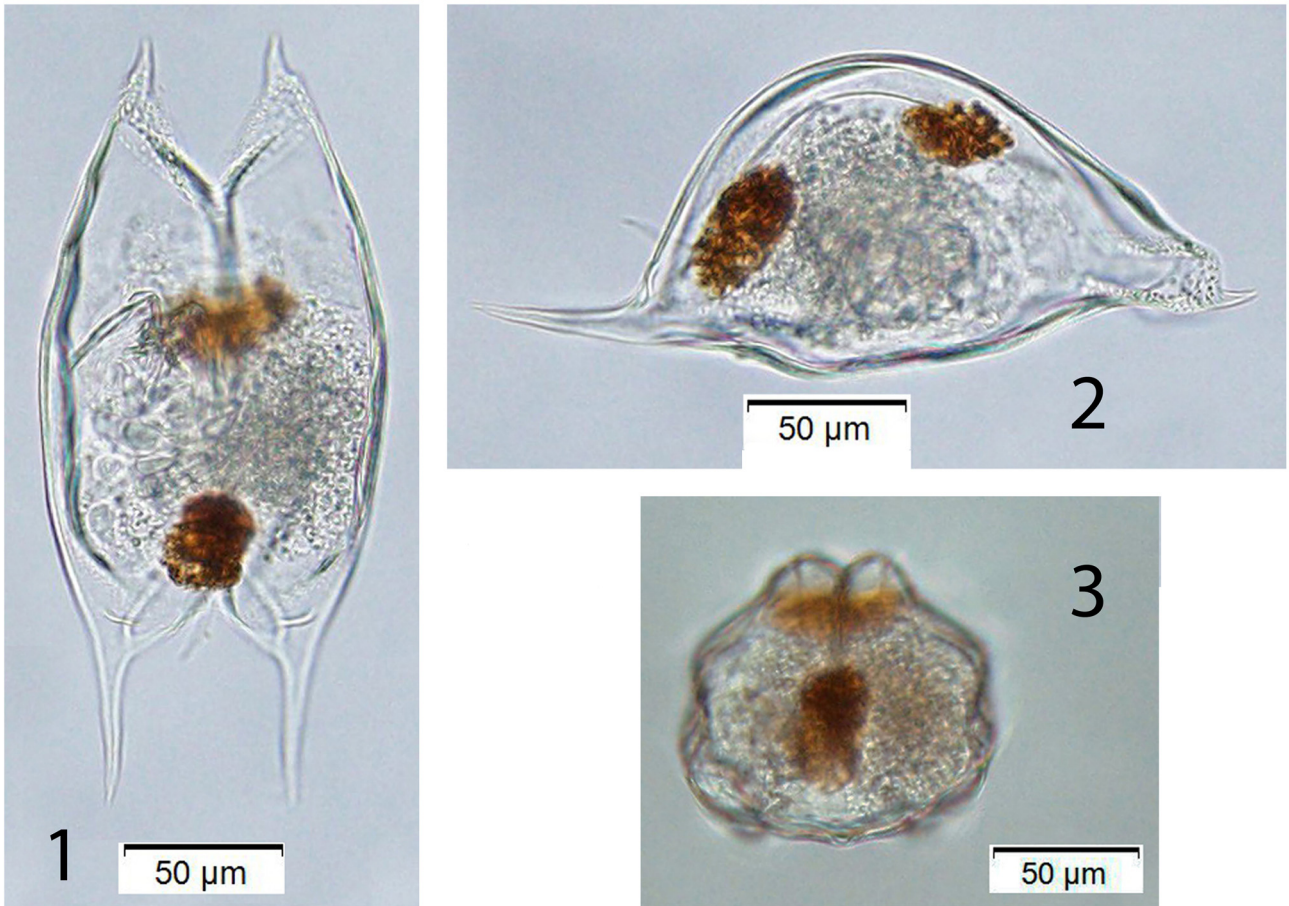
Genus *Mytilina* Bory de St. Vincent, 1826

***Mytilina wangi* n. sp.**

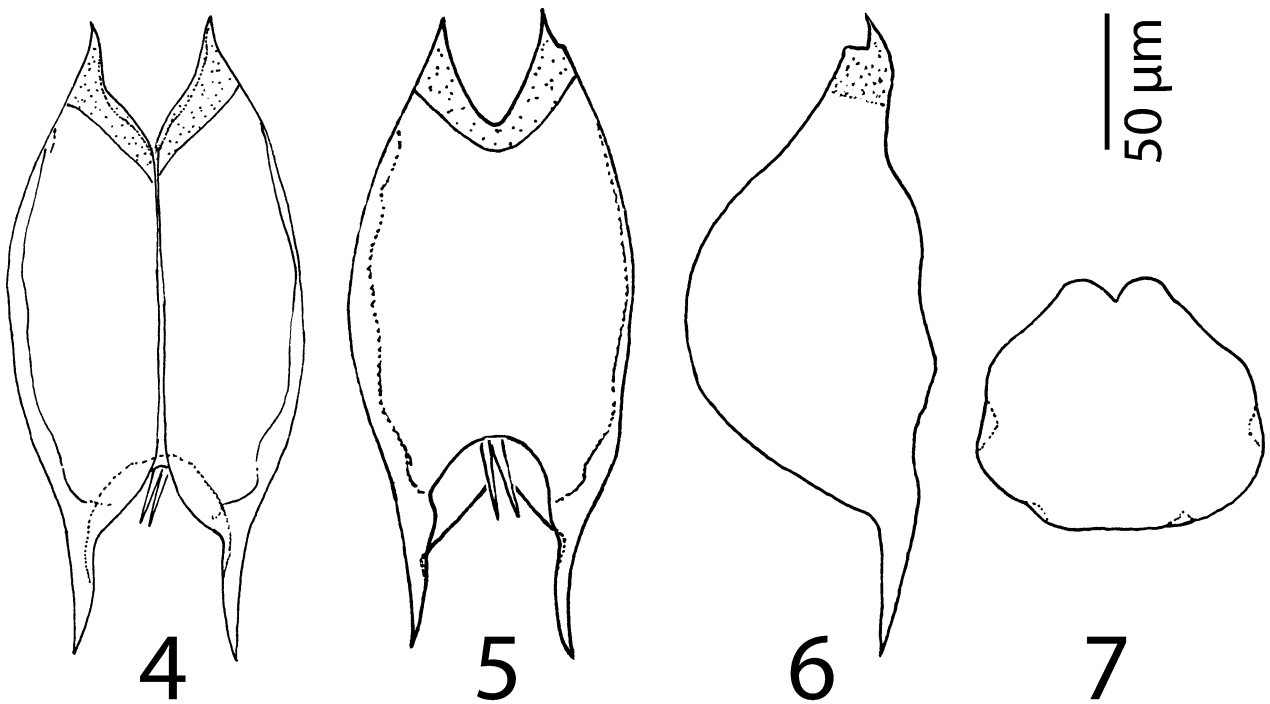
(Figs 1–7)

Type locality and types. A shallow pond south of Wuritala Sumu, in a place locally called Anda Tribe, Inner Mongolia, P. R. China, July 18th, 2013 (N 43°05'24.5", E 116°03'03.3", Altitude 1302 m). The surface of the pond is about 50 by 150 m. pH 8, Temperature 29.2° C.

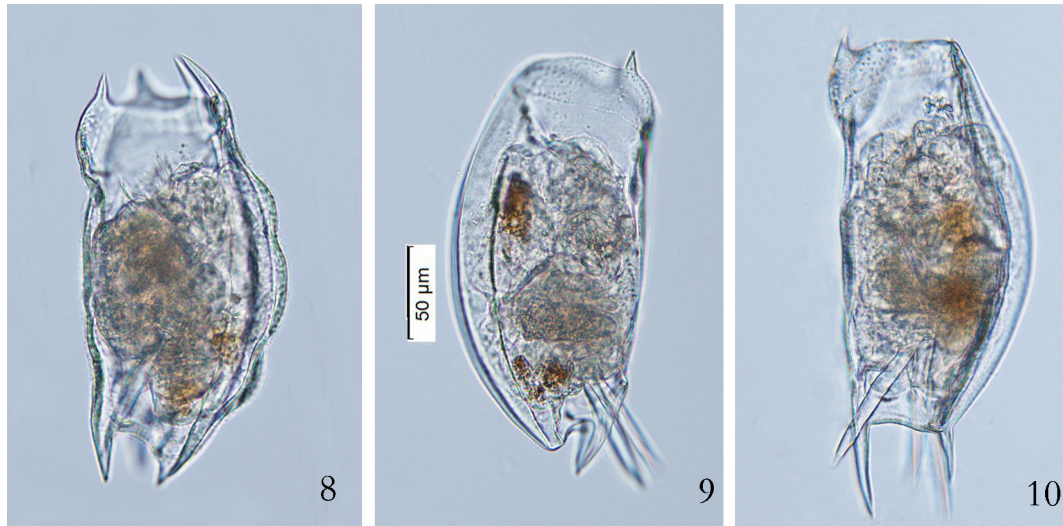
Holotype: 1 female specimen in permanent slide, deposited in RBINS (IG32753, RIR 215); Paratype: 1 female specimen in permanent slide, deposited in SHNU.



FIGURES 1–3. *Mytilina wangi* n. sp.. Photomicrograph of specimens. 1: ventral, 2: lateral, 3: frontal view.



FIGURES 4–7. *Mytilina wangi* n.sp.. 1: dorsal, 2: ventral, 3: lateral, 4: cross section.



FIGURES 8–10. Photomicrographs of other *Mytilina* spp. from the type locality. 8: *M. mucronata*; 9: *M. brevispina*; 10: *M. ventralis*.

Differential diagnosis. *Mytilina wangi* sp. nov. most closely resembles species of the *Mytilina mucronata - ventralis* group, by having a clearly developed stippled collar and a pair of anterior and of posterior ventral spines. It can, however, hardly be confused with any of its congeners by its remarkably arched lorica and low head aperture. These features are especially obvious in lateral view. The species further has the shortest toes of all taxa in the group.

Description. Lorica stiff, smooth, transparent, with a granulated collar surrounding the head aperture, strongly arched dorsally in lateral view, ventral lorica relatively flat longitudinally, convex transversally. Lateral lorica plates longitudinally convex, dorsally divided by a deep sulcus running from head aperture to posterior end of lorica. Head aperture broad but low, dorsally a V-shaped, ventrally a U-shaped sinus, with a pair of sharp ventral spines present laterally of the head aperture. and a pair of longer, sharp spines beside the foot opening. Foot opening broad, U-shaped ventrally, V-shaped sinus dorsally, lateral lorica plates drawn out into a pair of sharp, elongate ventral spines lateral of the foot aperture. Foot pseudosegments indistinct. A pair of equal, relatively short, slender toes present, without claws. Trophus malleate. Measurements as in Table 2.

TABLE 2. Measurements of 4 specimens of *Mytilina wangi* n. sp. (in µm).

	Lorica length	Lorica width	Lorica height	Toe length
Specimen 1	237	108	88	28
Specimen 2	246	112	92	29
Specimen 3	231	110	95	*
Specimen 4	266	114	101	*

*no reliable measurement could be made due to condition of the specimen.

Male unknown.

Ecology and distribution. Only 4 specimens of *Mytilina wangi* n. sp. were found at the type locality, and the species has not been found in any of the other samples collected during this study. This indicates that the species is rare, and it must be considered endemic to Inner Mongolia. However, the habitat in which the species occurred is a relatively weedy pond in a shallow depression along road G207 in an otherwise rather arid region (Fig. 11). The water was alkaline, and the co-occurring rotifers (Table 3) represent a relatively species-rich assemblage, including three congeners, *M. brevispina*, *M. ventralis*, and *M. mucronata*.

Etymology. The species is named after the first author's supervisor, Professor Quanxi Wang of SHNU.

TABLE 3. Rotifer fauna co-occurring with *Mytilina wangi* n. sp. in the type locality.

<i>Asplanchnopus multiceps</i> (Schrank, 1793)
<i>Asplanchnopus</i> cf. <i>hyalinus</i> Harring, 1913
<i>Brachionus quadridentatus</i> Hermann, 1783
<i>Cephalodella gibba</i> (Ehrenberg, 1830)
<i>Colurella obtusa</i> (Gosse, 1886)
<i>Colurella uncinata</i> (Müller, 1773)
<i>Dicranophorus grandis</i> (Ehrenberg, 1832)
<i>Dipleuchlanis propatula</i> (Gosse, 1886)
<i>Euchlanis dilatata</i> Ehrenberg, 1832
<i>Euchlanis incisa</i> Carlin, 1939
<i>Euchlanis triquetra</i> Ehrenberg, 1838
<i>Keratella tropica</i> (Apstein, 1907)
<i>Lecane bulla</i> (Gosse, 1851)
<i>Lecane closterocerca</i> (Schmarda, 1859)
<i>Lecane cornuta</i> (Müller, 1786)
<i>Lecane curvicornis</i> (Murray, 1913)
<i>Lecane elsa</i> Hauer, 1931
<i>Lecane furcata</i> (Murray, 1913)
<i>Lecane hamata</i> (Stokes, 1896)
<i>Lecane inermis</i> (Bryce, 1892)
<i>Lecane luna</i> (Müller, 1776)
<i>Lecane lunaris</i> (Ehrenberg, 1832)
<i>Lecane ohioensis</i> (Herrick, 1885)
<i>Lecane quadridentata</i> (Ehrenberg, 1830)
<i>Lecane stenroosi</i> (Meissner, 1908)
<i>Lecane ungulata</i> (Gosse, 1887)
<i>Lepadella patella</i> (Müller, 1773)
<i>Lepadella benjamini</i> Harring, 1916
<i>Lepadella triptera</i> (Ehrenberg, 1832)
<i>Lophocharis salpina</i> (Ehrenberg, 1834)
<i>Mytilina brevispina</i> (Ehrenberg, 1830)
<i>Mytilina mucronata</i> (Müller, 1773)
<i>Mytilina ventralis</i> (Ehrenberg, 1930)
<i>Notommata copeus</i> Ehrenberg, 1834
<i>Platyonus patulus</i> (Müller, 1786)
<i>Platyonus polyacanthus</i> (Ehrenberg, 1834)
<i>Platyias quadricornis</i> (Ehrenberg, 1832)
<i>Ploesoma lenticulare</i> Herrick, 1885
<i>Polyarthra longiremis</i> Carlin, 1943
<i>Pompholyx sulcata</i> Hudson, 1885
<i>Scaridium longicaudum</i> (Müller, 1786)
<i>Squatinella lamellaris</i> (Müller, 1786)
<i>Squatinella mutica</i> (Ehrenberg, 1832)
<i>Testudinella incisa</i> (Ternetz, 1892)
<i>Testudinella patina</i> (Hermann, 1783)
<i>Trichocerca porcellus</i> (Gosse, 1851)
<i>Trichocerca rattus</i> (Müller, 1776)
<i>Trichocerca vernalis</i> (Hauer, 1936)
<i>Trichotria tetractis</i> (Ehrenberg, 1830)

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FIGURE 11. Photograph of the type locality of *Mytilina wangi* n. sp.

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