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A diagnostic species compendium of the genus *Mugilicola* Tripathi, 1960 (Copepoda)

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The genus *Mugilicola* Tripathi, 1960 consists of four species, i.e. *M. smithae* Jones & Hine, 1978, *M. australiensis* Boxshall, 1986, *M. bulbosa* Tripathi, 1960 and *M. kabatai* Piasecki, Khamees & Mhaisen, 1991. A species compendium of the genus *Mugilicola* is presented. Morphological differences occur mainly in the shape of the body, its length, the armature of cephalic appendages, mouthparts, armature of the legs, and genital complexes.

Key words: Compendium, copepod, morphology, *Mugilicola* sp., parasite.

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Introduction

The family Therodamasidae (no longer a valid family) was based upon the genus *Therodamas* Krφyer, 1863 (Boxshall 1986). This family consisted of three genera: *Therodamas* Krφyer, 1863, *Paeonodes* Wilson, 1944 and *Mugilicola* Tripathi, 1960. The genus *Mugilicola* was established (Tripathi 1960) to accommodate a new copepod parasite found on *Mugil* sp. from India.

Paeonodes and *Mugilicola* are cosely related and share the same tagmosis, but their relationship with the type genus, *Therodamas* is slight (Boxshall 1986). According to Boxshall (1986), the neck of *Therodamas* is not homologous to that of *Mugilicola* and *Paeonodes*. The neck of the latter is postcephalic in origin, whereas that of *Therodamas* is of cephalic origin.

Paeonodes and *Therodamas* characteristicly have four pairs of legs, while *Mugilicola* has only three. The legs in *Therodamas* are spaced apart, but close together in *Mugilicola* and *Paeonodes* (Pillai & Jayasree 1978).

A review of the family Therodamasidae, published by Boxshall (1986) brought about a change in the taxonomic status of this family. All three genera, i.e. *Mugilicola*, *Paeonodes* and *Therodamas*, have mouthparts of the basic ergasilid type, (Boxshall 1986). The possession of these typical ergasilid cephalic appendages, as well as the lack of a maxilliped in adult females, are diagnostic apomorphies of the family Ergasilidae. As these characteristics are present in all three genera, it justifies their incorporation into the Ergasilidae (Boxshall 1986). These three genera would then be derived mesoparasitic representatives of a typically ectoparasitic family. This suggestion by Boxshall (1986) has been accepted, and the family Therodamasidae is synonymous with the family Ergasilidae.

Mugilicola bulbosa, Tripathi, 1960 was the first species described. Descriptions of *M. smithae* Jones & Hine, 1978, and *M. australiensis* Boxshall, 1986 followed and the most recent species described is *M. kabatai* Piasecki *et al.*, 1991. *Mugicola* specimens occur as mesoparasites on the gills of their hosts which are estuarine fishes. Mullets seem to be the preferred hosts (Kruger, Avenant-Oldewage, Wepener & Oldewage 1998; Kruger, Avenant-Oldewage & Cyrus 1997).

Materials and Methods

A species compendium of the genus *Mugilicola*, compiled from original species descriptions, redrawn from the originals as well as from additional morphological studies on *M. smithae*, (Kruger *et al.* 1998) is presented. This species compendium was compiled for various reasons i.e. it is easier to add new morphological data to a species compendium, with the aid of a species compendium unknown species can be identified more rapidly and accurately, only certain features of an existing compendium may be needed to identify a new species (Esser, Perry & Taylor 1976).

Results

Total body length and body shape

M. bulbosa is the shortest (1.30mm), *M. australiensis* a little longer (2.31mm), and *M. smithae* (4.3mm) and *M. kabatai* (4.17mm) are nearly equal in length; both nearly twice as long as *M. bulbosa* and *M. australiensis* (Table 1).

M. kabatai has a longer and narrower neck than *M. bulbosa* (Table 1) and the overall appearance resembles that of *Paeonodes nemaformis* Hewitt, 1969 (Piasecki et al. 1991). According to Boxshall (1986), *M. australiensis* also has a longer and narrower neck than that of *M. bulbosa*. Boxshall (1986) found that the neck is more clearly separated from the trunk in *M. australiensis* than in *M. bulbosa*. *M. smithae* is similar to *M. kabatai* in the separation of the neck and trunk (Table 1).

The oval-shaped genito-abdomen of *M. smithae* is distinguishable from the genito-abdomens of *M. bulbosa* and *M. australiensis* (Table 1). The genito-abdomen of *M. kabatai* is similar in shape to that of *M. smithae*, although that of *M. kabatai* is slightly flattened dorso-ventrally (Piasecki et al. 1991). In *M. australiensis* the genito-abdomen is slightly broader than the neck and these two parts are not clearly delimited (Table 1).

Table 1 Total body length and major body parts of *Mugilicola* spp.

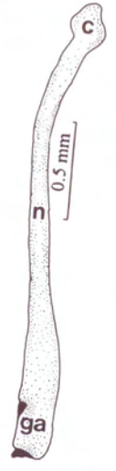
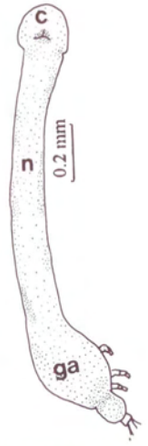
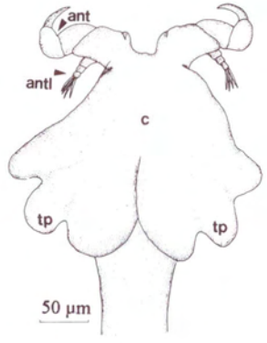
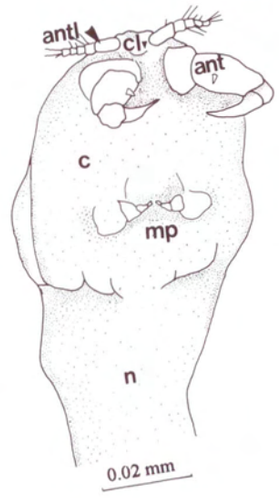
Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
Total body length: 4.3 mm (n=9). Body shows no external segmentation. Small ovoid cephalon, with trilobular processes on postero-lateral margins. Shape of process not constant. Neck cylindrical with no appendages. Comprises 50-60% of total body length, merges into trunk without visual segmentation. In many cases neck covered in connective tissue capsule produced by host. Oval-shaped genito-abdomen, bearing three pairs of legs ventrally.  	Total body length: 4.17 mm (n=4). Segmentation almost completely lost. Cephalon irregularly ovoid with prominent swelling on dorsal side (not a holdfast). Cylindrical neck elongated anterior part of the thoraxs, bears no appendages. Neck may be twisted around longitudinal axis. Cephalothorax covered by connective tissue capsule. Genito-abdomen very large and broad, flattened slightly dorso-ventrally. Three pairs of legs ventrally.  	Total body length: 2.31 mm (n=1). No obvious external segmentation. Small cephalon widest posteriorly, no cephalic lobes. Very long slender neck, over 60% of total body length). Neck merges imperceptibly with broader genito-abdomen. Genito-abdomen slightly broader than neck, three pairs of legs ventrally.  	Total body length: 1.053 – 1.566 mm. No external segmentation. Oval cephalon dorsally covered by carapace. Long narrow neck, no appendages. Posterior part of genito-abdomen swollen three pairs of legs ventrally. 
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)
c = cephalon; ga = genito-abdomen; n = neck; O.U.R. = Own unpublished results			

Table 2 Head and associated structures of *Mugilicola* spp.

Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	Mugilicola bulbosa Tripathi 1960
Ovoid cephalon very small (width 0.44 mm and length 0.47 mm, n=9).	Irregular ovoid cephalon with swelling on dorsal side (width 0.25 mm and length 0.33 mm).	Small cephalon (width 0.18 mm and length 0.2 mm).	Oval cephalon (width 0.18 mm and length 0.145 – 0.261 mm long).
Trilobular process occurs on postero-lateral margins. Appearance varies from well developed to absent.	No trilobular process.	Trilobular process absent.	Trilobular process absent.
Minute sensory openings present antero-dorsally on cephalon.	Rostrum-like structure with minute sensory openings and setae present on anterior end of cephalon. Similar sensory openings and convex lens-like structure on dorsal side of cephalon. Concentration of pigment underneath cuticle.	—	—
Antennulae and antennae anterior on head and curved from dorsal to ventral side. 	Antennulae and antennae ventrally. 	(Cephalon of holotype damaged and only antennae are intact). —	Antennulae and antennae present —
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)

ant = antennae; antl = antennulae; c = cephalon; cl = convex lens structure; tp = trilobular process; O.U.R. = Own unpublished results; __ = No information available

Table 2 (continued) Head and associated structures of *Mugilicola* spp.

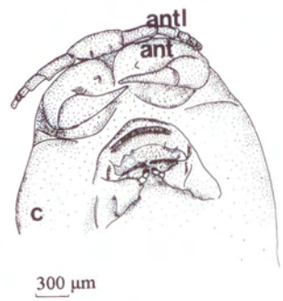
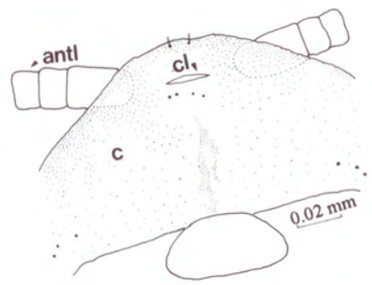
Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
	 	—	—
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)
ant = antennae; antl = antennulae; c = cephalon; cl = convex lens structure; mp = mouth parts; O.U.R. = Own unpublished results; __ = No information available			

Table 3 Structure of antennulae and antennae of *Mugilicola* spp.

Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
Antennulae consists of five cylindrical segments, microscopically clearly visible.	Antennulae five segmented, cylindrical segments clearly delimited.	(Antennulae not intact)	Antennulae five segmented.
Segments bears setae ventrally varying in length and number between podomeres as well as between individual setae.	Diameter of segments diminishes towards distal end. Length about equal except for first segment which is twice as long. Length of setae varies, and occupy only ventral side of appendage except for one setae which is slightly dorsal.	—	—
Setal formula: 13;4;1;2;4.	Setal formula: 10;5;3;3;5.	—	—
First segment longer than wide and longer than succeeding podomeres, 13 setae anteriorly.	First segment bears ten setae.	—	First segment longest.
Second segment longer than wide with four setae of which one seta is apart.	Second segment with five setae.	—	Second segment shortest.
Third segment wider than long, bears one seta.	Third segment bears three setae.	—	Segment 3-5 more or less equal in length.
Fourth segment bears two setae on opposite sides.	Fourth segment bears three setae.	—	—
Fifth segment bears four setae.	Fifth segment bears five setae.	—	Five apical setae on fifth segment.
Antenna uniramous, consists of three segments.	Antennae uniramous, three segmented and subchelate.	Antennae subchelate.	Antennae prehensile, stout, consists of three segments.
First segments width nearly equal to length, no ornamentation.	First segment broad, short and unarmed.	First segment unarmed.	First segment short.
Distal margin of second segment curved, conical process medially on inner margin. Second segment the longest and tapers terminally.	Second segment most prominent, elongated with conical process on proximal half of the medial margin.	Second segment, small process on inner margin.	Second segment stout, conical process on inner margin.
Third segment terminates in claw-like structure that flexes toward second segment. Minute opening present dorsally near base of segment.	Third segment shorter, terminating in powerful claw.	Third segment terminal claw-like structure.	Third segment terminating in curved claw. Broad spine present near base of the claw.
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)
O.U.R. = Own unpublished results; __ = No information available			

Table 3 (continued) Structure of antennulae and antennae of *Mugilicola* spp.

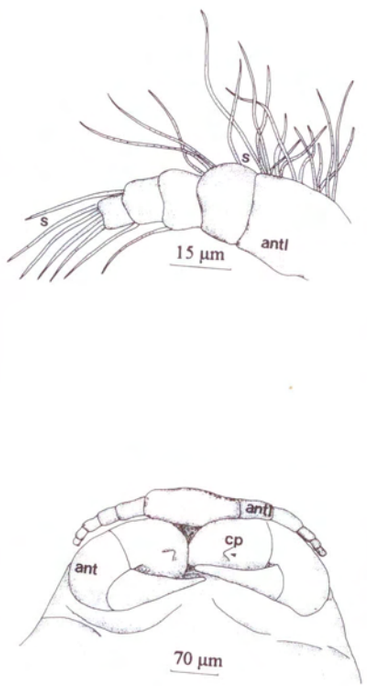
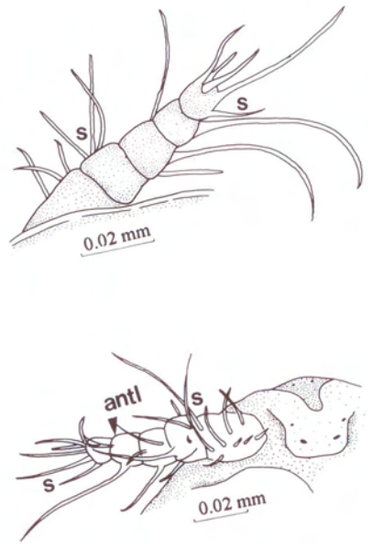
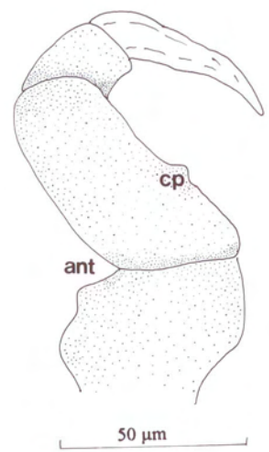
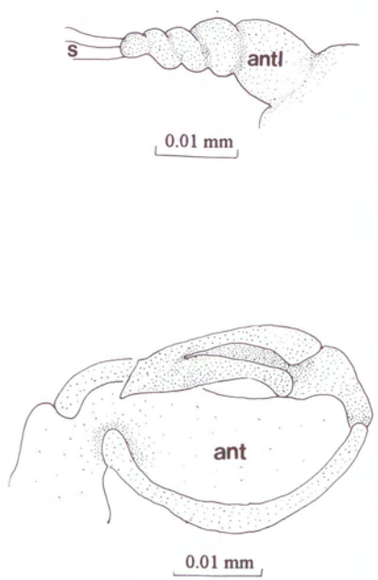
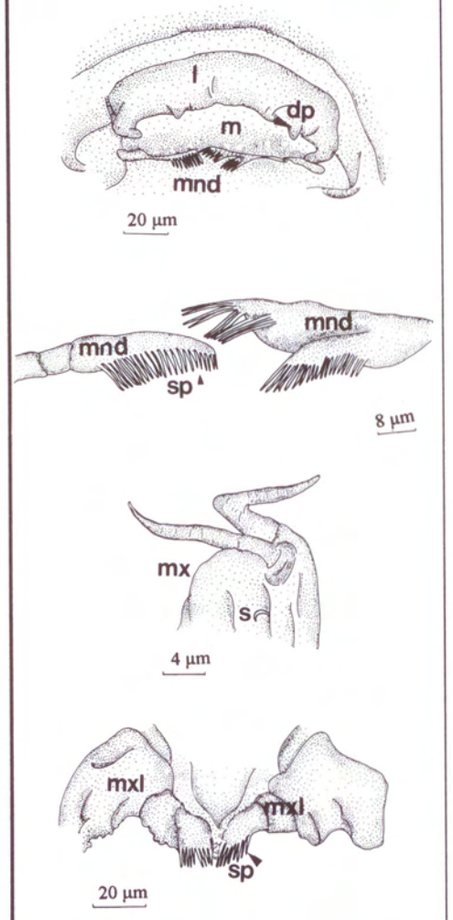
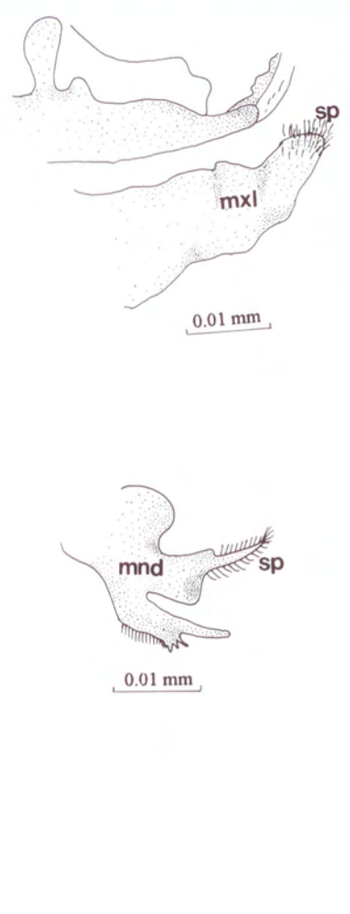
Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
			
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)
antl=antennulae; ant=antennae; cp=conical process; s=seta; O.U.R. = Own unpublished results; __ = No information available			

Table 4 Structure of mouth and associated mouthparts of *Mugilicola* spp.

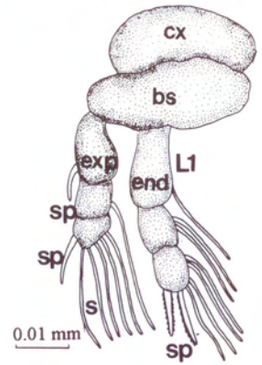
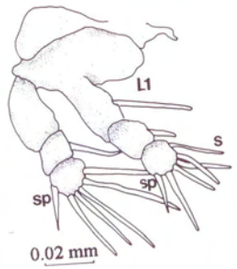
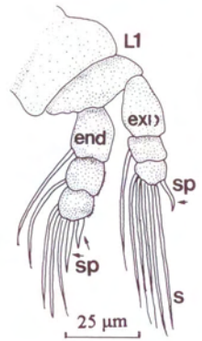
Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
Mouth situated medially on the ventral side of the cephalon.	Mouthparts consist of labrum, a maxillule, two maxillae and two mandibles.	—	—
Mouth a split-like opening bordered by labrum, maxillula, maxillae and mandibles.	—	—	—
Labrum plate-like and situated anterior to the mouth. Covers the mouth and mandible and has four distinct dental projections, on the anterior curved margin.	Labrum triangular with posterior part clearly delimited. Armed with four sharp dental projections, and covers mouth opening and mandibles.	—	—
Maxillulae situated between the maxillae, are small, conical structures. Each bears two apical setae and a small curved seta medially on conical structure.	Maxillula very small rounded structure with two apical setae. Present between maxilla and edge of labrum.	—	Maxillulae are very small, one jointed and uniramous.
Maxillae each consist of three segments, terminal segment rounded, armed with many small spines on distal margin.	Maxillae uniramous and four segmented. First segment robust, not clearly delimited from basic surface. Second segment smaller, tapers off towards third segment that is round and armed with spines.	—	Maxillae two jointed with second joint round and covered with many small spines.
Mandibles broad segment that divides into two spatulate-like structures. Each has row of fine spines on inner margin, giving a comb-like appearance.	Mandibles minute with two spatulate blades. Margins armed with spines.	—	Mandibles two jointed. Terminal joint blade with fine setae along the margin. Mandibular palp with four spines near the distal end.
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)
O.U.R. = Own unpublished results; __= No information available			

Table 4 (continued) Structure of mouth and associated mouthparts of *Mugilicola* spp.

Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
			—
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)

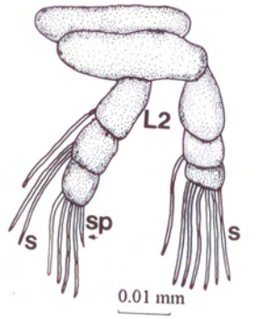
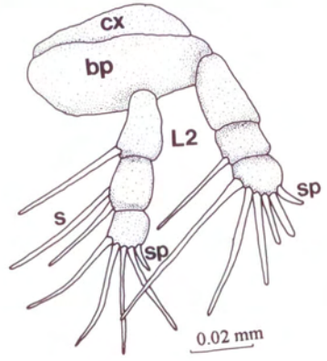
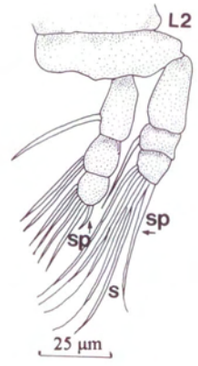
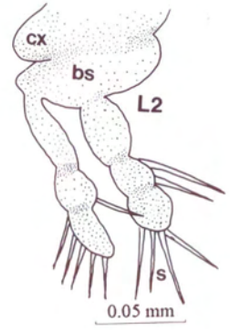
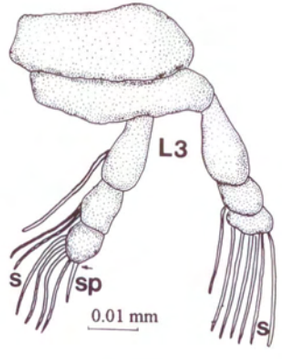
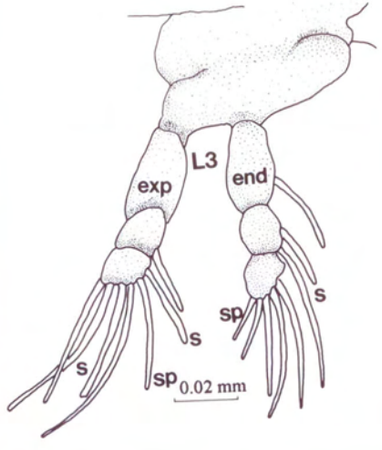
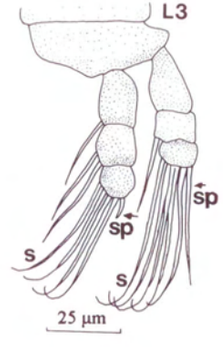
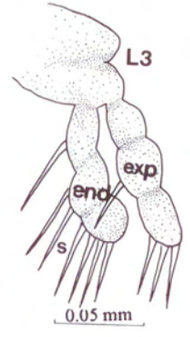
dp=denticle projections; l=labrum; m=mouth; mnd=mandible; mx=maxillule; mxl=maxilla; s=seta; sp=spines; O.U.R. = Own unpublished results; __= No information available

Table 5 Structure of legs and associated armature of *Mugilicola* spp.

Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
Three pairs of biramous legs ventrally on oval-shaped genito-abdomen. First pair situated in centre of genito-abdomen, second and third pairs at posterior margin of genito-abdomen. Each pair connected by well developed interpodal bar. The occurrence of setae and spines on legs 1-3 is as follow: (spines represented by Roman numerals and setae by Arabic numerals). Endopod Exopod First pair 0-1;0-2;II-4 I-0;0-1;I-5 Second pair 0-1;0-2;I-4 0-0;0-1;0-6 Third pair 0-1;0-2;I-4 0-0;0-1;0-6  	Three pairs of legs, biramous with rami three-jointed. Location of legs similar as for *M. smithae*. Interpodal bar well developed. The occurrence of setae and spines on legs 1-3 is as follow: (spines represented by Roman numerals and setae by Arabic numerals). Endopod Exopod First pair 0-1;0-1;I-5 0-0;0-1;I-5 Second pair 0-1;0-2;I-4 0-0;0-1;0-6 Third pair 0-1;0-2;I-4 0-0;0-1;I-5  	Three pairs of legs, biramous with rami three-jointed. Location of legs similar as for *M. smithae*. — The occurrence of setae and spines on legs 1-3 is as follow: (spines represented by Roman numerals and setae by Arabic numerals). Endopod Exopod First pair 0-1;0-1;II-3 0-0;0-1;I-5 Second pair 0-1;0-2;I-4 0-0;0-1;I-5 Third pair 0-1;0-2;I-4 0-0;0-1;I-5  	Three pairs of biramous legs, rami three segmented. Location of legs similar to *M. smithae*. — The occurrence of setae and spines on legs 1-3 is as follow: (spines represented by Roman numerals and setae by Arabic numerals). * Endopod Exopod First pair 0-1;0-1;I-4 0-0;0-1;I-5 Second pair 0-1;0-2;0-4 0-0;0-1;0-5 Third pair 0-1;0-2;0-4 0-1;0-1;0-5 
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)

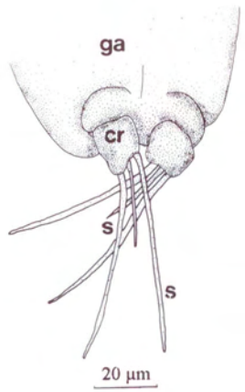
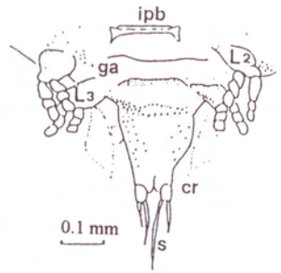
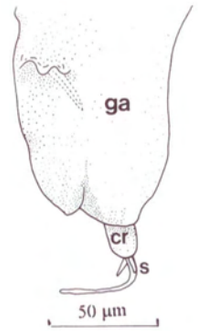
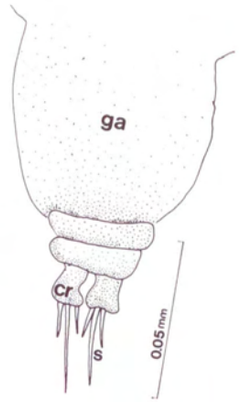
bs = basis; cx = coxa; end = endopod; exp = exopod; L1 = leg 1; L2 = leg 2; L3 = leg 3; s = seta; sp = spine; O.U.R. = Own unpublished results; __= No information available; * = See text

Table 5 (continued) Structure of legs and associated armature of *Mugilicola* spp.

Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
			
			
			
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)

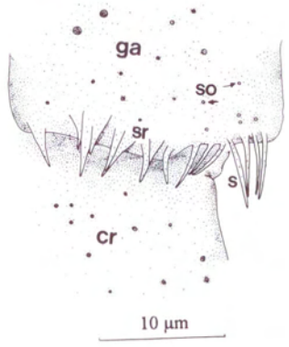
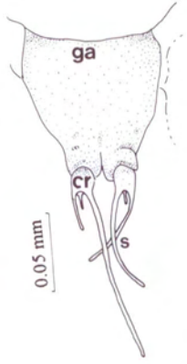
bs = basis; cx = coxa; end = endopod; exp = exopod; ipb = interpodal bar; L1 = leg 1; L2 = leg 2; L3 = leg 3; s = seta; sp = spine; O.U.R. = Own unpublished results; __ = No information available; * = See text

Table 6 Abdominal and genital structures of *Mugilicola* spp.

Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
Genito-abdomen consists of fused segments and posterior segment that bears caudal rami.	Very small "hindbody" with retained segmentation in center of posterior margin of genito-abdomen. Consists of genital complex with oviduct orifices dorso-ventrally, and two segmented abdomen with caudal rami.	A small urosome, directed postero-ventrally present and consists of fused genital complex and abdominal segment bearing caudal rami.	Two caudal rami occur, each bearing three apical setae.
Three pairs of fine setal rows present on ventral side of genito-abdomen with additional group of setae anterior to rows of setae. Ventral side of genito-abdomen with minute sensory openings.	Three pairs of denticle rows present on ventral side of genito-abdomen.	—	—
Each of two caudal rami terminates in three setae of which central seta is shorter. Single row of setae surrounds the basis of each caudal ramus.	Each caudal ramus bears three setae with one shorter than other two. Small seta present near base of lateral seta.	At least three setae present on each caudal ramus.	—
In most cases two egg sacs present.	Two egg sacs are present.	—	Egg sacs very small, comprises 4-5 longitudinal rows of eggs. Each row with 6-7 eggs.
			
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)

cr = caudal rami; ga = genital abdomen; s = setae; O.U.R. = Own unpublished results; __= No information available

Table 6 (continued) Abdominal and genital structures of *Mugilicola* spp.

Mugilicola smithae Jones & Hine 1978	*Mugilicola kabatai* Piasecki *et al.* 1991	*Mugilicola australiensis* Boxshall 1986	*Mugilicola bulbosa* Tripathi 1960
			—
Reference: Jones & Hine (1978); Kruger *et al.* (1998)	Reference: Piasecki *et al.* (1991)	Reference: Boxshall (1986)	Reference: Tripathi (1960)
ab = abdomen; cr = caudal rami; s = setae; so = sensory openings; sr = setal rows; O.U.R. = Own unpublished results; __= No information available			

Cephalon and associated structures

The presence of trilobic processes on the cephalon of *M. smithae* distinguishes this species from the other three (Table 2), although it was recently indicated that the shape of the trilobic process is not a constant feature (Kruger et al. 1998). Jones & Hine (1978) state that *M. smithae* is similar to *P. nemaformis*, as the latter also has a lobed cephalon. According to Piasecki et al. (1991) *M. kabatai* has a swelling on the dorsal side (Table 2) (it cannot be considered a holdfast) which is absent in the other three species (Table 2).

Mugilicola and *Therodamas* differ from other genera of the Ergasilidae in that the abdomen is longer than the cephalon (Tripathi 1960).

Mugilicola smithae has sensory openings antero-dorsally on the cephalon. *Mugilicola kabatai* has minute sensory hairs and openings on the anterior end of the cephalon, as well as a convex lens-like structure (Table 2) dorsally on the cephalon (Piasecki et al. 1991). A concentration of pigment is present underneath the cuticle in *M. kabatai*. Similar pigment was absent in *M. smithae*.

The setation of the antennule differs between *M. smithae* and *M. kabatai*. The first segment has three more setae than that of *M. kabatai*. The second, fourth and fifth segments of the antennule of *M. smithae* have one less seta than that of *M. kabatai*. *M. smithae* has two less setae than *M. kabatai* on the third segment (Table 3). *M. bulbosa* also has one more seta than *M. smithae* on segment five (Table 3). No information on the setation of *M. australiensis* exists. Only apical setae on the fifth segment of *M. bulbosa* has been mentioned (Tripathi 1960).

The basic structure of the antennae of all four species is similar. *M. smithae* has an opening on the dorsal side near the basis of the third segment, whilst in *M. bulbosa* a spine is present near the basis of the claw (Tripathi 1960).

A small curved seta is present on the maxillula of *M. smithae* (Table 4). According to Tripathi (1960), the maxillae of *M. bulbosa* have two segments. This differs from the maxillae in *M. smithae* and *M. kabatai* in that their maxillae consist of three clearly delimited segments (Table 4). The structure of the mouthparts of *M. australiensis* is unknown, as the cephalon of the holotype was damaged.

Structure of legs and associated armature

The structure of the legs of all four species is similar but setation and armature differ. The endopods of the second and third pairs of legs are similar for all species except *M. bulbosa*, which has one less spine on the endopod of the second and third pair of legs (Table 5). The exopod of the first pair of legs of *M. smithae* bears one more spine than the other species. *M. bulbosa* has one seta less than *M. australiensis* on the apex of the endopods of all three legs (Table 5). The number and position of setae and spines on the endopod of the first leg differ in all four species (Table 5).

Abdominal and genital structures

Three pairs of fine rows of setae are present on the ventral surface of the genito-abdomen of *M. smithae* and *M. kabatai* (Table 6), and a single row of setae, which surrounds the basis of the caudal rami, is present in *M. smithae*. The hindbody located by Piasecki et al. (1991) on *M. kabatai* was not described for any of the other species. An additional seta was found near the base of the lateral seta in *M. kabatai*.

Discussion

Although terminology differs in the papers by Tripathi (1960), Boxshall (1986), Jones & Hine (1978) and Piasecki et al. (1991) respectively, uniform terminology is used here. The term trilobate process was used by Jones & Hine (1978) whilst Boxshall (1986) used the term cephalic lobes instead. Here the term trilobic process is used. The term head as used by Jones & Hine (1978), Boxshall (1986) and Piasecki et al. (1991), is replaced by cephalon, as used by Tripathi (1960). The term maxilliped used by Jones & Hine (1978) is replaced by the term maxilla for the following reasons: Boxshall (1986) represents the opinion that the genera *Paeonodes*, *Therodamas* and *Mugilicola* should rather be seen as highly transformed species of the family Ergasilidae because they have typical ergasilid appendages. No maxilliped is present in the females of Ergasilidae, and according to Boxshall (1986) these are diagnostic apomorphies of the family Ergasilidae.

Tripathi (1960) based the family Therodamasidae on the genus *Therodamas*. According to Kabata (1979), no maxillipeds are known for either sex of *Therodamas*. Furthermore, the term caudal rami is used both by Boxshall (1986) and Jones & Hine (1978) and Piasecki et al (1991). Tripathi (1960) used the term anal laminae. The term caudal rami is used here. Jones & Hine (1978) describe *M. smithae* with a very long and narrow neck with a lobed cephalon. Jones & Hine (1978) states that these features are similar to those found in *P. nemaformis*, but are unlike the illustrations of *M. bulbosa* given by Tripathi (1960). *M. kabatai* differs from *M. smithae* in the shape of the cephalon, where the latter has trilobic processes on the cephalon, and the setation of the antennule where *M. smithae* has four apical setae and *M. kabatai* has five (Piasecki et al. 1991). *M. bulbosa* has five apical setae on the antennulae, whereas *M. smithae* only has four (Jones & Hine 1978). A feature, which differentiates *M. kabatai* from *M. australiensis*, is a more distant separation of the neck from the genito-abdomen (Piasecki et al. 1991). *M. australiensis* differs from *M. smithae* in the shape of the head (*M. smithae* has trilobic processes), and from *M. bulbosa* having a longer and narrower neck and the small size of the urosome (Boxshall 1986). *M. bulbosa* differs from *M. kabatai* where the latter has a better separation between the cephalon and the abdomen (Piasecki et al. 1991).

Jones & Hine (1978) claimed that the second segment of the endopod of the second leg bears only one seta. Boxshall (1986) attributed the latter to an error in labelling of the legs by Jones & Hine (1978). Boxshall (1986) suggested that is was unlikely for legs one and three to have two setae on this segment whilst the second leg bears one seta. The present study agrees with Boxshall (1986). The setal and spinal formula given by Tripathi (1960) in his species description of *M. bulbosa* does not correspond with the line drawings given. According to Tripathi (1960) the endopod of the first pair of legs has a seta on the first segment, but the line drawings do not show this seta. The drawing of the exopod of the first pair of legs shows an extra on the second segment, whilst in the formula only one is mentioned. The seta described for the first segment on the endopod of the second pair of legs does not

show in the line drawings. Tripathi (1960) furthermore described a seta on the first segment of the exopod of the third pair of legs, but his drawing does not show this. Two setae on the third segment of the exopod of leg three are missing in his drawing, whilst it is given in the setal formula.

It is important to re-examine the legs of *M. bulbosa* (Table 5) to confirm these irregularities. According to Jones & Hine (1978), the legs of *M. bulbosa* are all less setose than the legs of *M. smithae*. *M. bulbosa* has one armature less than *M. australiensis* on the apex of the endopod of all the legs.

The four species can be distinguished on the length, overall body structure, cephalic armature, mouthparts, and armature on legs and genital complexes.

Acknowledgements

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