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The larval morphology and host of the Australian water mite *Limnochares australica* (Acari: Hydrachnidia: Limnocharidae)

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Abstract – The present study deals with the larval morphology and host-parasite association of *Limnochares* (*Cyclothrix*) *australica*, a water mite from standing waters throughout Australia. The larva can be separated from the other described *Limnochares* spp. larvae, including the other *Cyclothrix* species of the area *L. (L.) crinita* by its unusual leg claws.

The larvae of *Limnochares australica* were found as parasites of the water strider *Tenagogerris pallidus* (Gerridae, Hemiptera, Insecta). *Limnochares australica* is the only known *Cyclothrix* species parasitizing Gerridae.

INTRODUCTION

The water mite *Limnochares (Cyclothrix) australica* Lundblad, 1941a inhabits standing waters in widespread regions of Australia. So far, the species is known from Tasmania, Victoria, New South Wales and Western Australia (Harvey, 1990, 1998). The second author collected the species also in the Northern Territory and in the Kimberley (northern Western Australia). Hence, it is likely that the species occurs throughout Australia. Outside Australia, the species has been reported from New Zealand (Smit, 1996).

Adults of *Limnochares australica* and *L. (Cyclothrix) crinita* Koenike, 1898 from India and Africa are impossible to separate. Cook (1967) based his separation on the disjunct distribution of the genus. The adult specimens from New Zealand were also similar to those from Australia (Smit, 1996), and were therefore assigned to *L. australica*. Harvey (1990) suggested that the larvae might provide useful characters to distinguish the two species. As the larva of *L. crinita* has been described (Wiles, 1993), the first aim of this paper is to give a detailed description of the larva of *L. australica* and draw conclusions on the conspecifity of the two species. When a larval description is available from New Zealand specimens, a similar conclusion can be drawn on the taxonomic status of the New Zealand populations.

Larvae of water mites are usually parasitic on freshwater organisms, mostly insects. So far, very few host relationships have been reported from Australia, and almost nothing is known about the life cycle of Australian water mites. One record of a water mite larva came from Canestrini (1884), who reported *Hydrachna odontognatha* Canestrini, 1884 parasitic on a water beetle. Unfortunately, his description of the larva is inadequate, and the species is considered a *species incerta*. The only Australian species of which more is known on the life cycle is *Physolimnesia australis* Halík, 1940. Proctor (1997) reported that the larvae forgo the parasitic stage. Hitherto, there is only one well-supported host-parasite association for Australian water mites. Womersley (1954) reported a mite, *Mackerrasiella globus* (later transferred to *Hydryphantes globus* Womersley, 1954 by Vercammen-Grandjean, 1972), as parasite of a dolichopodid fly. Thus, the second aim of this paper is to report an additional host for an Australian water mite species.

METHODS AND MATERIALS

Larvae of *Limnochares australica* were taken from the water strider *Tenagogerris pallidus* Andersen and Weir, 1997 (Hemiptera, Gerridae). These water striders were collected by the second author from a pool near the Manning Gorge Falls, The Kimberley, Western Australia on 13 September 1998. For the identification of the larvae the keys of Prasad and Cook (1972) and Smith and Cook (1991) were used. Moreover, adults of *L. australica* were abundant in this pool and it is assumed that the larvae belong to this species.

Two males and one female water strider were collected and preserved in Koenike's fluid. Six water mite larvae were attached to these three water striders: antennal segment 2 (larva 1, gerrid 2), dorsal side of thorax (larva 2, gerrid 1), abdominal segment VII (larva 3, gerrid 3), frons of

head (larvae 4 and 5, gerrids 2 and 3) and femur of first leg (larva 6, gerrid 2).

The larvae were in bad condition (lack of setae, legs and gnathosoma, damaged idiosoma). A preliminary description is given nevertheless, because the most remarkable characters are visible. The larva is described according to the nomenclature of Prasad and Cook (1974) and Smith and Cook (1991). All measurements are given in µm. If more than one specimen was measured, range and mean are given in parentheses.

Abbreviations are used as follows: CXI-CXIII: coxal plate I-III; Mp1-Mp2: mediopropodosomal setae 1-2; Lp1-Lp2: lateropropodosomal setae 1-2; C1-C4: coxal setae 1-4; Mmcp: medial margin of coxal plate; Pmcp: posterior margin of coxal plate; V1-V4: ventral setae 1-4; PI-PV: palpal segment I-V; IL1-IL6: 1st segment of the Ist leg – 6th segment of the Ist leg; IIL1-IIL6: 1st segment of the IInd leg - 6th segment of the IInd leg; IIIL1-IIIL6: 1st segment of the IIIrd leg – 6th segment of the IIIrd leg; Expp: excretory pore plate.

Description of the larva of *Limnochares australica*

The only larva with an intact idiosoma is specimen 1 which is obviously only slightly engorged (see Figure 1A). Length of its ovate idiosoma is 581, width 456. In the other 5 larvae, the idiosoma is very swollen. Many setae are lacking on the gnathosoma, idiosoma and legs; often, leg setae are represented only by the setal bases.

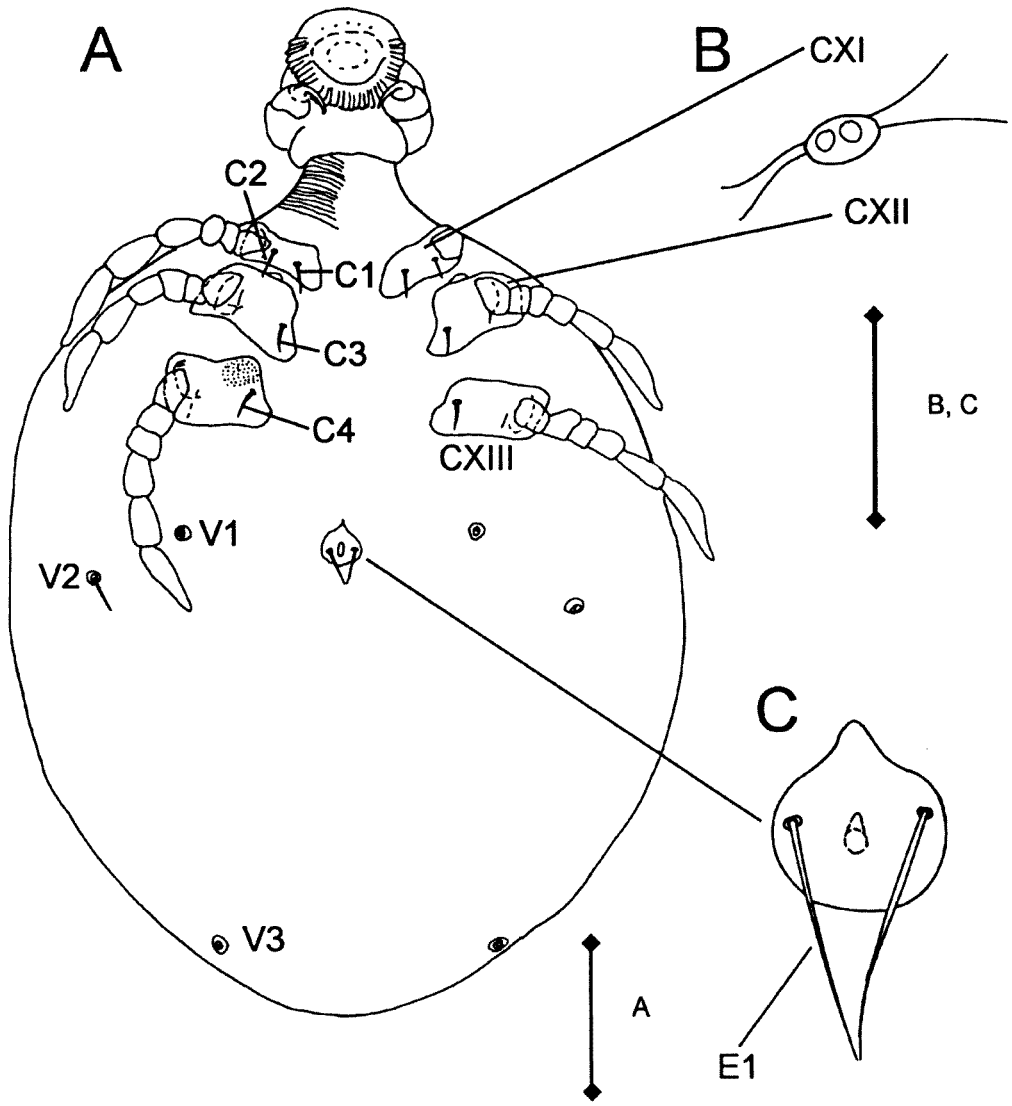

Figure 1 Larva of *Limnochares australica*. A. specimen 1 ventral; B. urstigma located between coxal plates CXI and CXII; C. excretory pore plate (specimen 4). Scale bars: A 100 µm, B, C 20 µm.

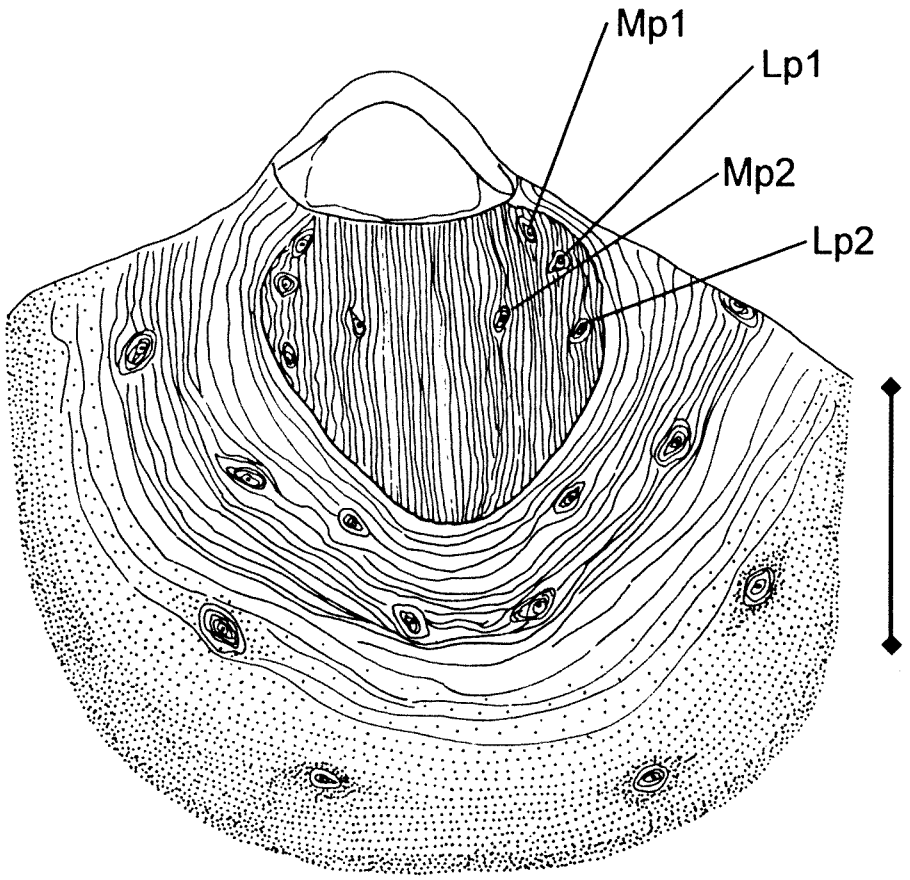

Figure 2 Larva of *Limnochares australica*. Propodosomal region showing setal bases (specimen 4). Scale bar 100 µm.

Dorsal idiosoma (see Figure 2): Integument noticeably porose, only lined around the small, distinctly lined dorsal plate which bears 4 pairs of setae; idiosoma posterior to dorsal plate with 6 pairs of visible setae. Dorsal plate length (n=2) 105-118 (111), width (n=3) 133-143 (137). Eye capsule length (n=2) 25-28 (26), Mp1-Mp1 (n=1) 89, Mp2-Mp2 58, Lp1-Lp1 109, Lp2-Lp2 116, Mp1-Lp1 14, Mp2-Lp2 56, Mp1-Mp2 37, Lp1-Lp2 28.

Ventral idiosoma (Figure 1A): Integument lined; sclerotization of the separate coxal plates porose. CXI bearing two setae, CXII and CXIII bearing one seta each. Each urstigma in two parts (Figure 1B). Only three pairs of setal bases of ventral setae visible. Length CXI (n=2) 35-39 (37), width 73-74 (74), length CXII (n=3) 45-49 (47), width 71-79 (74), length CXIII 40-43 (42), width 71-75 (72), C1-C2 (n=2) 16-19 (18), C1-Mmcp 18-18 (18), C4-Pmcp 16-18 (17), C1-C4 95-107 (101), C1 (n=1) 31, C2 23, C3 22, C4 25, V1 (n=2) 32-36 (34), V2 (n=1) 54. Excretory pore plate drop-shaped, bearing only one pair of setae (Figure 1C). Excretory pore oblong, lying between excretory pore plate setae; length of these setae (n=3) 60-88 (77), distance between them 56-72 (63). Length of Expp (n=3) 80-100 (96), width 80-92 (87).

Gnathosoma: Distinctly set off from the idiosoma (see Figure 1A). Length of PII (n=1) 32, length of PIII 21, length of palpal claw 20.

Legs of more-or-less equal length (Figure 3A-C). Two types of tarsal claws (Figure 3D), one simple and falciform, the other with lamella-like widening at its base. Chaetotaxy of the legs not clear, often not even setal bases visible. All leg segments lined and this is particularly distinct on distal segments (Figure 3D).

Leg I (Figure 3A): total length (n=3) 198-208 (203); length IL1 25-28 (27), IL2 21-23 (22), IL3 22-23 (22), IL4 37-38 (37), IL5 37-38 (37), IL6 64-66 (65); height IL1 23-25 (24), IL2 25-26 (25), IL3 26-28 (27), IL4 22-23 (22), IL5 23-24 (24), IL6 18-19 (19).

Leg II (Figure 3B): total length (n=4) 191-208 (199); length IIL1 27-29 (28), IIL2 22-27 (25), IIL3 21-23 (22), IIL4 27-29 (28), IIL5 34-37 (36), IIL6 60-63 (61); height IIL1 23-25 (24), IIL2 22-23 (23), IIL3 24-25 (25), IIL4 22-23 (22), IIL5 23-24 (24), IIL6 17-18 (18).

Leg III (Figure 3C): total length 189-205 (197); length IIIL1 24-27 (26), IIIL2 24-25 (25), IIIL3 21-23 (22), IIIL4 27-29 (28), IIIL5 36-39 (37), IIIL6 57-62 (59); height IIIL1 22-24 (23), IIIL2 21-22 (21), IIIL3 21-23 (22), IIIL4 18-21 (20), IIIL5 20-21 (20), IIIL6 16-20 (18).

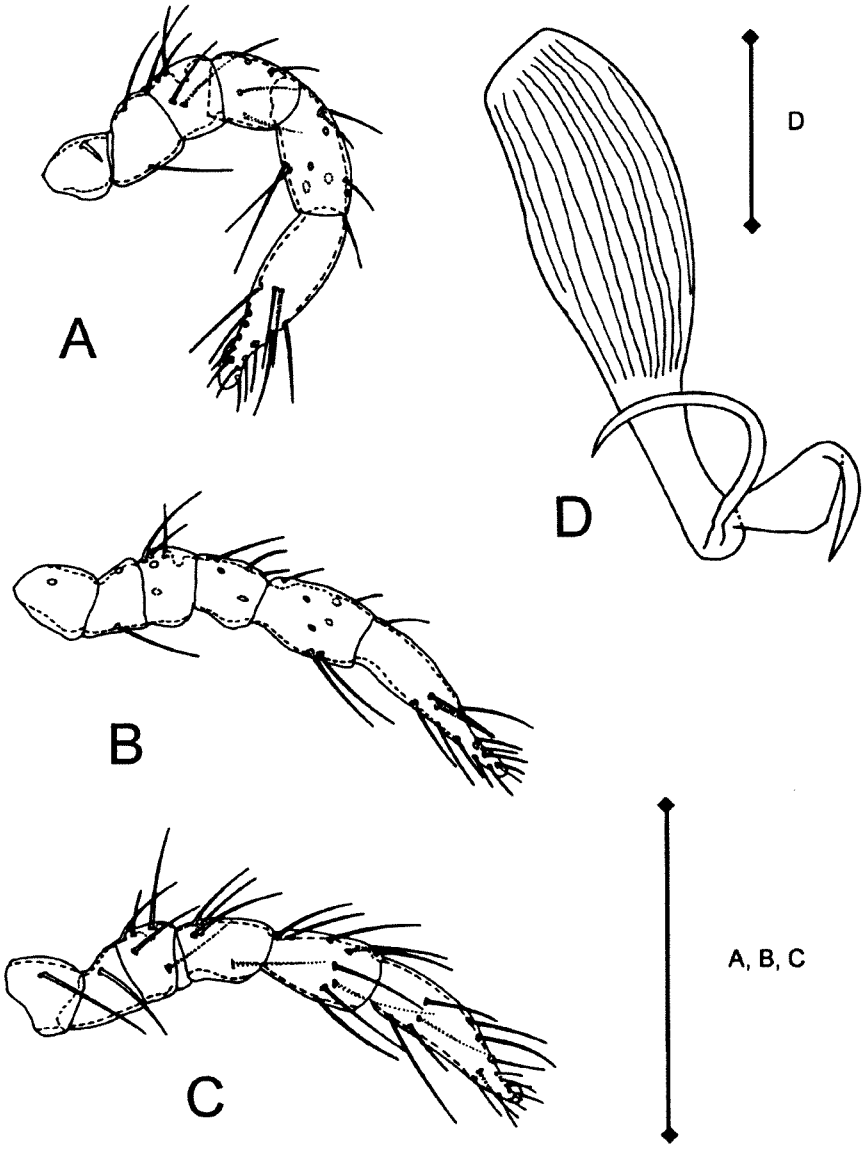

Figure 3 Larva of *Limnochares australica*. Legs (different specimens). A. IL lateral. B. IIL lateral. C. IIIL lateral. D. Leg segment 6 and claws of leg I, setae not drawn. Scale bars: A–C 100 µm, D 20 µm.

DISCUSSION

The family Limnocharidae is divided into the two subfamilies Limnocharinae and Rhyncholimnocharinae (see Cook, 1974). The only known larva in the latter subfamily, *Rhyncholimnochares kittatinniana* Habeeb, 1954, was described by B.P. Smith (1989). There are marked differences in morphology and parasitism between this *Rhyncholimnochares* larva and the known larvae of *Limnochares*. The larva of *Rhyncholimnochares kittatinniana* is characterized by a dorsal plate bearing 7 pairs of setae and an excretory pore plate devoid of setae. In contrast to the larvae of *Limnochares*, larvae of *R. kittatinniana* parasitize elmid beetles.

In the subfamily Limnocharinae, five species of the genus *Limnochares* are known worldwide. There are two subgenera described, *Limnochares* with one holarctic species, and *Cyclothrix*, with species known from Africa, Asia, Australia and North America. Larval descriptions of *L. (Limnochares) aquatica* (Linnaeus, 1758) are given by Lundblad (1927) and Wainstein (1980), of *L. (Cyclothrix) americana* Lundblad, 1941b by Crowell (1963) and Prasad and Cook (1972) and *L. (Cyclothrix) crinita* by Wiles (1993). The following discussion on morphological data is based on these descriptions.

The larva of *L. (Cyclothrix) australica* shows some characters which separates the species from the other known Limnocharinae. The most distinct character is found in the claws. All larvae of the Limnocharidae bear only two claws, a specific characteristic of the family. In larval *L. americana, L. crinita* and *L. aquatica* both claws are equal, heavy, long and falciform. In *L. australica*, only one claw belongs to this common *Limnochares* type, the other

claw is exceptional, even in most other water mite larvae. A claw of the lamelliform type is common in some adult and nymphal water mites, but hardly found up to now in larvae. Two other water mite larvae with lamelliform claws are *Stygomomonia mitchelli* I.M. Smith, 1989 (Momoniidae) and the species already mentioned above, *Rhyncholimnochares kittatinniana*. Other characters separating *L. australica* from other *Limnochares* larvae are the pronounced linear patterns on the dorsal plate and on the distal leg segments.

Larval morphology of the two *Cyclothrix* species *L. australica* and *L. crinita* indicate that these are two distinct species. The larvae show the following differences: *L. crinita* lacks the peculiar claws of *L. australica*, the dorsal plate of *L. crinita* is rectangular in contrast to the more rounded plate in *L. australica* and the coxal plates of *L. crinita* bear a scale like pattern which is not visible in *L. australica*.

This comparison of larval morphology of described *Limnochares* species revealed the possibility of separating the subgenera. A striking difference between *L. (Limnochares) aquatica* and *L. (Cyclothrix) americana* is in the number of ventral setae. *L. americana* bears three pairs of setae, *L. aquatica* only two. Differences in other characters are only slight, e.g., the shape of the dorsal plate (posteriorly more rounded in *L. americana* and more ellipsoid in *L. aquatica*) and the chelicera (base of chelicera oblong and slender and chela relatively long in *L. americana*, proximal part of the base of chelicera relatively high, chela short and stunted in *L. aquatica*). This difference in number of ventral setae also holds for the other two *Cyclothrix* spp., *L. crinita* and *L. australica*. Other differences relate to the shape of the dorsal plate and the excretory pore plate. Up to now, these subgenera have only been distinguished by the different number of ventral setae i.e., two pairs of ventral setae in *Limnochares* s.str. and three pairs in *Cyclothrix*.

Up to now water striders (Gerridae) were only known to be parasitized by *Limnochares* s.str. larvae (Smith and Oliver, 1986; Smith and Cook, 1991); however this study shows the subgenus *Cyclothrix* to also have larvae which parasitize species in this hemipteran family. The host *Tenagogerris pallidus* is known from north and northwest Australia, with one doubtful record from Perth (Andersen and Weir, 1997). As *L. australica* occurs throughout Australia, it is postulated that other gerrid species are parasitized. Additional recorded hosts for *Limnochares* are other Hemiptera (Hydrometridae, Mesoveliidae) and Odonata (Smith and Oliver, 1986; Smith and Cook, 1991). Thus, other hosts in addition to Gerridae are possible for *L. australica*, most probably among the Hemiptera.

The two species *L. australica* and *L. crinita* are also separable by their different host taxa. In contrast to the water strider parasite *L. australica*, *L. crinita* parasitizes Odonata (Wiles, 1993). The separation of the *Limnochares* subgenera by their host taxa is not possible by the so far reported hosts.

The autecology of *Limnochares aquatica* was studied in great detail by Böttger (1972), and parts of the life cycle of *L. americana* were described by Crowell (1963). As in the present study for *Limnochares australica*, Böttger (1972) reported different attachement sites on gerrid hosts for *L. aquatica*; parasites were found on all three tagmata of the hosts.

Based on the description of the larva of *L. australica* presented here, the *Limnochares* species from New Zealand (see Smit, 1996) may possibly be classified systematically from its larval morphology and host-parasite association.

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