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Microfaunal Diversity in a Biodiversity Hotspot: New Rotifers from Southwestern Australia

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Hendrik Segers and Russell J. Shiel (2003) Microfaunal diversity in a biodiversity hotspot: new rotifers from southwestern Australia. *Zoological Studies* **42**(4): 516-521. We present the descriptions of 3 new and apparently endemic species of rotifer (Rotifera: Monogononta: Lecanidae, Trichocercidae). *Lecane halsei* sp. nov. belongs to the *L. ludwigii* (Eckstein)-group, and is diagnosed by the absence of a posterior projection on the lorica. The taxonomy of the *L. ludwigii*-group is commented upon. *Lecane noobijupi* sp. nov. is a sister taxon of the common, cosmopolitan *L. bulla* (Gosse), whereas *Trichocerca wanarra* sp. nov. is close to *T. insignis* (Herrick), *T. myersi* (Hauer), and *T. plaka* (Myers), but the trophi are characteristic. The 3 new species illustrate the diversity of the freshwater microfauna in southwestern Australia, and the need for a thorough taxonomic approach to biodiversity inventories of cryptic microfaunal groups.
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Key words: Monogononta, Taxonomy, New species.

Southwestern Australia has long been recognized as a biodiversity hotspot because of its rich and endemic vascular flora (Myers et al. 2000). However, it is becoming clear that many invertebrate groups are also diverse and contain high levels of endemism. Aquatic macroinvertebrates have received the most attention (e.g., Davis and Christidis 1997), but little is yet known of the region's freshwater microfauna (Frey 1991, Storey et al. 1993, Halse 2002). In particular, its fauna of the Rotifera, generally the most diverse taxon of primary freshwater organisms in aquatic environments, is still relatively poorly known.

In their review of the region, Koste et al. (1983) listed 83 rotifers in the region, but this number has more than doubled during the last decade (e.g., Storey et al. 1993, Pinder et al. 2000). Most of the recent studies, however, list microfauna as a byproduct of wider-scale ecological investigations. Unfortunately, the effort dedicated to taxonomy in such studies is frequently inadequate to unravel the identity of rare or difficult taxa. Inventories generated in this way commonly include incompletely identified taxa, uncertain identifications, and references to incompletely separated collective groups. This situation is particularly relevant when taxa of cryptic organisms like the minute and taxonomically difficult Rotifera are being dealt with, even more so when taxonomic information on the fauna of the study region is scarce. Evaluating biodiversity status of a fauna based on such data is thus difficult.

Herein we describe 3 new species of rotifer found during an inventory of freshwater habitats in southwestern Australia. These new taxa are elements of the endemic freshwater fauna, and constitute a significant qualitative contribution to the biodiversity of the region.

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MATERIALS AND METHODS

Rotifers were collected using pond nets with a 50-μ mesh size and were preserved in 1%-2% buffered formaldehyde. Samples were subsequently stored in 70% alcohol. Specimens were examined and drawn using an Olympus CH-2 microscope with a drawing tube; trophi processed following the methods by Segers (1993) and Segers and Dumont (1993) were examined using a Jeol JSM 840 scanning electron microscope. Acronyms of repositories are as follows: WA museum: Western Australian Museum, Perth, Australia; KBIN: Royal Belgian Institute for Natural Sciences, Brussels, Belgium. All measurements are in μm.

RESULTS

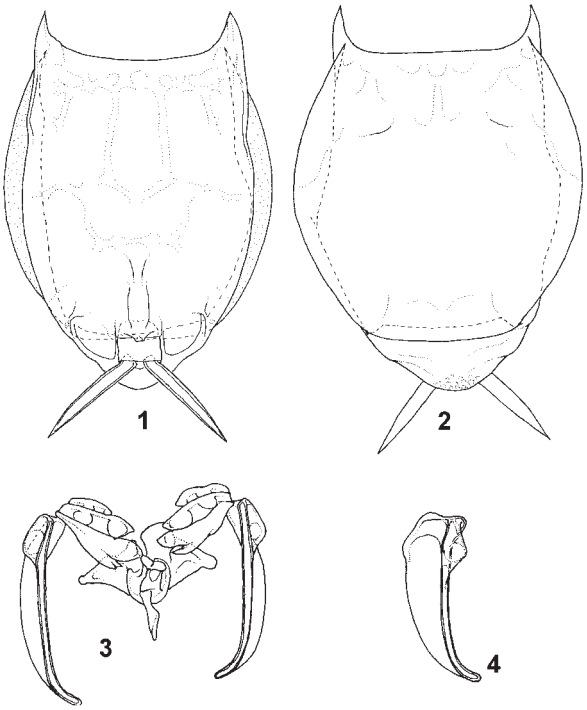
Lecanidae Remane, 1933

Lecane halsei sp. nov.

(Figs. 1-4)

?*Lecane* sp. after Koste & Shiel (1990): fig. 12.1.

Type materials: Holotype, 3 slides with 1 paratype each, 2 slides with 3 paratypes, all from the type locality, a small dam in Lake Magenta Nature Reserve, 50 km S of Lake Grace Township, Western Australia (33°29'31''S 119°5'23''E), 26 Aug. 1998, coll. A. Pinder and J. McRae. Sample depth 60 cm, water temperature 21°C, conductivity 723 μS cm^{-1}, pH 8.09, DO 88% satd. Holotype, 2 paratype slides in WA Museum (WAM Z13492 and WAM Z13493, respectively), 3 paratype slides in KBIN (IG 29746 RIR 142-144).



Figs. 1-4. *Lecane halsei* sp. nov.: 1. Ventral view; 2. Dorsal view; 3. Trophi, ventral view; 4. Left manubrium, lateral view.

Differential diagnosis: *Lecane halsei* sp. nov. probably belongs to the *L. ludwigii* (Eckstein, 1883) group. All taxa belonging to this group share a more or less similar lorica morphology, and are distinguished by differently shaped posterior projections on the foot plate. In *L. halsei* sp. nov., such a projection is absent, although the foot plate has a particularly broad and convex posterior margin. Following the key by Segers (1995a), *L. halsei* sp. nov. keys out to *L. levistyla* (Oloffson, 1917). The latter, however, has weaker anterolateral projections, non-coincident head aperture margins, a smooth lorica and an evenly curved posterior margin with no indication of a posterior projection.

Description (Female, male unknown): Lorica stiff. Dorsal plate anteriorly narrower, medially wider than ventral plate, ornamented. Head aperture margins coincident, straight. Anterolateral corners with strong, straight spines. Ventral plate longer than wide, ornamented. Lateral margins weakly convex or nearly straight, with weak notches posterior to head aperture, posterior margin pronouncedly convex. Transverse fold incomplete. Lateral sulci mostly deep, occasionally superficial. Prepedal fold narrow and elongate, distally with a median projection bearing a pore. Foot pseudosegment squarish, simple, non-projecting. Toes with straight inner margin, parallel-sided except for a basal notch externally, and smoothly tapering to a point at distal 1/3. No claws or pseudoclaws.

Trophi submalleate. Unci nearly symmetrical, with three unequal teeth and clearly developed subuncinal teeth. Rami triangular, asymmetrical, with large median projection on left ramus.

Measurements (all in μm): Ventral lorica length, 107-114; width, 72-79; dorsal lorica length, 91-103; width, 88-95; toe length, 38-42; head aperture wid-th, 57-63; anterior spine length, 15-17; manubrium length, 29.2-31.3; rami width, 24.0, right uncus length, 15.6; left uncus length, 14.6; fulcrum length, 8.9.

Remarks: *Lecane halsei* sp. nov. appears to belong to the taxonomically complex and contro-

versial *L. ludwigii*-group. Whereas Koste and Shiel (1990) treated several of the included taxa as different species, Segers (1995a) considered them to be of infrasubspecific rank. He argued that the taxonomic relevance of a feature that exhibits a wide range of variability in a number of recognizable taxa, is questionable, and concluded that taxa diagnosed solely on this feature should be treated as synonyms. However, it has recently become clear that a number of taxa included in the *L. ludwigii*-group are not only easily and reliably diagnosed by the shape of the posterior projection, but that their taxonomic identity is supported by additional morphological and/or biogeographical features (e.g., the presence of unique recurved or barbed anterolateral spines, and the Neotropical distribution of *L. marshi* Harring, 1914, the Holarctic distribution of *L. stokesi* (Pell, 1890)). Considering that the extent of the variation in shape of the posterior projection in the different taxa of the *L. ludwigii*-group remains insufficiently documented, it appears premature to draw conclusions about the status of all named taxa in the group. In contrast to all other taxa in the *L. ludwigii*-group, *L. halsei* sp. nov. is the only taxon in which a clearly demarcated posterior projection is absent.

Koste and Shiel (1990) briefly mentioned and depicted a single specimen of a *Lecane* species from Lake Mulwala, Victoria, which they hesitantly placed in the vicinity of *L. mira* (Murray, 1913). As far as can be judged from their figure, that specimen may be *L. halsei* sp. nov.

Etymology: The new species is named after Stuart Halse, who has coordinated much of the invertebrate survey work in Western Australia.

***Lecane noobijupi* sp. nov.**

(Figs. 5, 6)

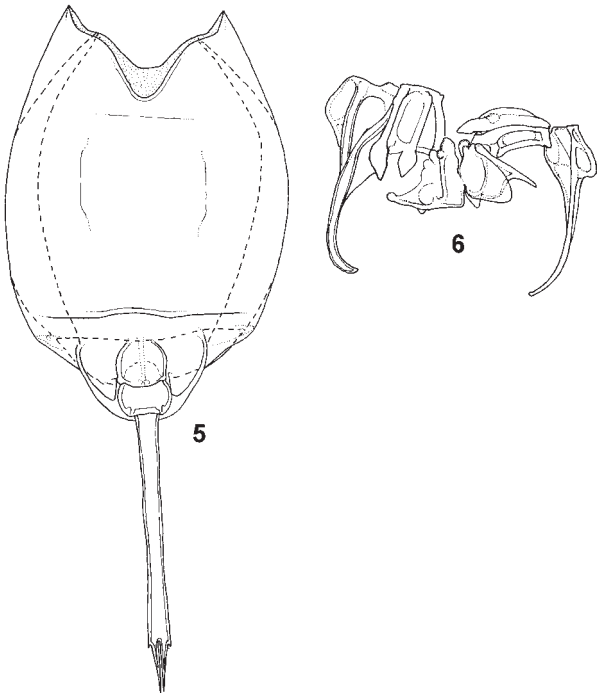
Lecane sp. near *bulla*: Segers (1995b).

Type materials: Holotype, 2 slides with 1 paratype each, 2 slides with 2 paratypes each from Noobijup Swamp, 70 km SE of Manjimup, Western Australia (34°23'05"S, 116°47'22"E), 15 Jan. 1997, depth 85 cm, water temperature 27.8°C, cond. 3630 μS cm^{-1}, pH 7.04, DO 46% satd. One paratype from Yarnup Swamp (34°22'28"S, 116°51'40"E), 15 Jan. 1997, depth 77 cm, water temperature 25-28°C, cond. 5110 μS cm^{-1}, pH 7.46, DO 68-96% satd., coll. A. Storey. Holotype and 2 paratype slides in WA Museum (WAM Z13494 and WAM Z13495, respectively), 2 paratype slides in KBIN (IG 29746 RIR 139-140).

Other materials examined: One specimen from Lake Angove, 30 km E of Albany, Western Australia (34°56'10"S, 118°9'40"E), 18 Feb. 1993, coll. S. Halse (Segers, 1995b), 1 specimen from Cobertup Swamp, 15 May 1997, coll. A. Storey.

Differential diagnosis: The egg-shaped lorica, and the foot and toe of *L. noobijupi* sp. nov. appear to indicate a close relationship with *L. bulla* (Gosse, 1851), and distinguishes the taxon from any other *Lecane* with which it could be confused, especially *L. lunaris* (Ehrenberg). The large anterolateral cusps of *L. noobijupi* sp. nov. clearly distinguish the species from *L. bulla*.

Description (Female, male unknown): Lorica stiff, egg-shaped. Dorsal plate anteriorly narrower, medially as wide as ventral plate, smooth. Head aperture margins deeply concave, dorsally less so than ventrally, laterally with large triangular cusps. Ventral plate longer than wide, weakly ornamented by 2 short, longitudinal striae. Lateral margins convex. Transverse fold incomplete. Lateral sulci deep. Prepedal fold short and broad, distally with a pair of covered pores. Uncovered part of foot pseudosegment relatively wide, with concave lateral margins, non-projecting. A single elongate toe bearing terminal pseudoclaws and accessory



Figs. 5-6. *Lecane noobijupi* sp. nov.: 5. Ventral view; 6. Trophi, ventral view.

claws, pseudoclaws separated by a fissure extending beyond insertion of accessory claws.

Trophi submalleate. Unci nearly symmetrical, with 3 unequal teeth. Fulcrum rounded distally, without basal plate. Rami triangular, slightly asymmetrical.

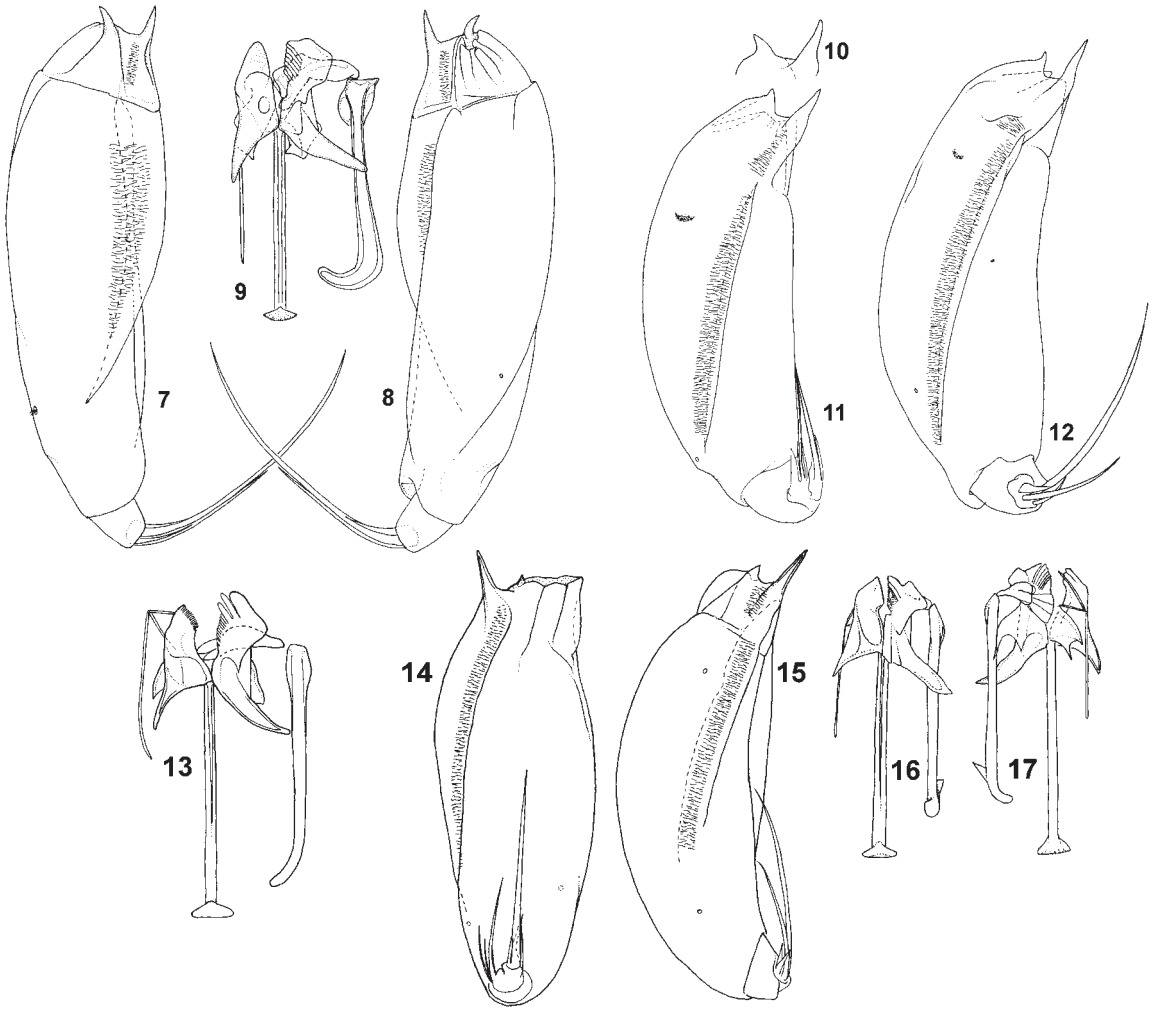
Measurements (all in μm): Ventral lorica length, 124-135; width, 91-96; dorsal lorica length, 99-125; width, 87-94; toe length (without pseudoclaw), 78-80; pseudoclaw 14-17; head aperture width, 41-48; ventral sinus depth, 17-22; dorsal, 9-12; manubrium length, 31.3; rami width, 24.5, right uncus leng-th, 16.7; left uncus length, 15.1; fulcrum length, 8.3.

Etymology: The name of the new species is a noun in the genitive case, derived from the species' type locality, Noobijup Swamp in Western Australia.

Trichocercidae Harring, 1913

Trichocerca wanarra sp. nov.
(Figs. 7-9, 18-22)

Type materials: Holotype, 1 slide with 1 paratype, 1 slide with 1 paratype trophi preparation, 1 paratype trophi SEM preparation, from pools on Wanarra Rock, 280 km NNE of Perth, Western Australia (29°31'27"S, 116°47'32"E), 8 Aug. 1999, A. Pinder and J. McRae. Sample depth 50 cm,



Figs. 7-9. *Trichocerca wanarra* sp. nov.: 7. Right lateral view; 8. Left lateral view; 9. Trophi, ventral view. **Figs. 10-13.** *Trichocerca myersi* (Hauer): 10. Anterior spines, detail; 11-12. Right lateral view (different specimens). 10, 11. ANSP 581, 12. Syntype of *T. tortuosa* (Myers), ANSP 359; 13. Trophi, ventral view (sub. *D. tortuosa*) ANSP 626. **Figs. 14-17.** *Trichocerca plaka* Myers: 14. Ventral view; 15. Right lateral view; 16. Trophi, ventral view; 17. Trophi, dorsal view (Goose Pond, NJ, USA. 25 Aug. 1996).

water temperature 17.2°C, cond. 193 μS cm^{-1}, pH 7.53, DO 100.5% satd. Holotype and trophi paratype in WA Museum (WAM Z13496 and Z13497, respectively), 1 paratype in KBIN (IG 29746 RIR 141).

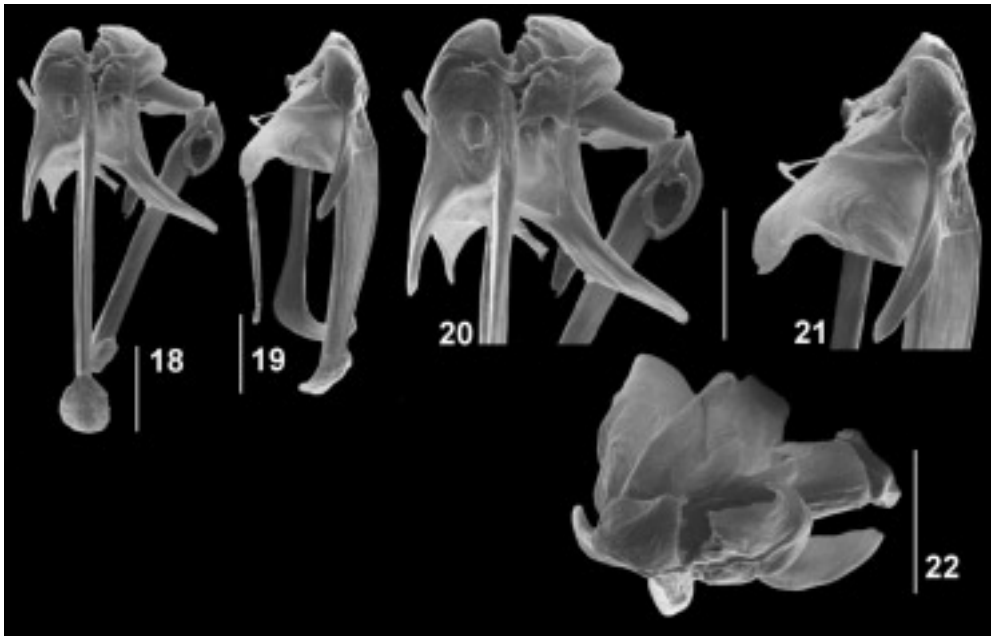
Additional materials examined:

- *Trichocerca insignis* (Herrick, 1885): Schlöh-See (Hol.), 8 Oct. 1936, Meuche Pr. 127 (sub. *Diurella insignis*. Coll. J. Hauer, in RUG); Almati Lake, Reg. Bez. Madras, India, 28. Oct. 1934 (sub. *Diurella insignis*. Coll. J. Hauer, in RUG)
- *Trichocerca myersi* (Hauer, 1931): ANSP 581 (Aneboda, Sweden, 30 July 1928), ANSP 359 (Pond, Bargaintown, Atlantic Co., NJ, USA 8 July 1934. Syntypes of *Diurella tortuosa* Myers, 1936), ANSP 626 (sub. *Diurella tortuosa*).
- *Trichocerca plaka* Myers, 1938: Goose Pond, NJ, USA, 25 Aug. 1996, l.&d. HS)

Differential diagnosis: The external morphology of *T. wanarra* sp. nov. is similar to that of *T. insignis* (Herrick, 1885), *T. myersi* (Hauer, 1931) (Figs. 10-13), and *T. plaka* Myers, 1938 (Figs. 14-17). *Trichocerca wannara* sp. nov. differs from *T. insignis* by the shape of the trophi (generally more slender, especially the left manubrium, in *T. insignis*). The distinction with the latter 2 species is based on the shape of the anterior spines (more strongly unequal in *L. plaka*), the height of the dorsal keel (highest in *T. wanarra* sp. nov.), the shape of the foot (relatively elongate in *T. wanarra* sp. nov.), and the substyli (external substyli relatively short and flat in *T. myersi*, and spiniform in *T. wanarra* sp. nov. and *T. plaka*), and trophi morphology. In particular, the left manubrium is relatively large, stout and strongly curved in *T. wanarra* sp. nov.

Description (Female, male unknown): Lorica relatively stiff. Body elongate, more or less straight. Left head region with a number of short transverse folds, right head region with a lamella bearing a proximal, curved spine and a distal spine pointing straight anteriorly. A small striated field present at base of head lamella. Lorica of head and trunk clearly separated by a transverse furrow. Head lamella prolonged on trunk lorica in a relatively high keel, extending to approximately 3/4 of trunk lorica. A conspicuous striated field present near base of keel. Openings of lateral antennae in distal 1/3 of body. Foot distally, relatively narrow at base, pointing slightly ventrally. Toe spines unequal, weakly and smoothly curved, inserted close together, the left twice as long as the right. One pair of accessory spiniform styli per toe spine.

Trophi strongly asymmetric. Fulcrum elongate, with anteromedial crest and basal plate. Left ramus with large alulus, pointing laterally. Left



Figs. 18-22. *Trichocerca wanarra* sp. nov., SEM photographs of trophi. 18. Ventral view; 19. Right lateral view; 20. Detail, ventral view; 21. Detail, right lateral view; 22. Frontal view (scale bars: 10 μm).

supraunci large, with median row of decurved denticules. Right ramus with elongate triangular alulus pointing posteriorly, suprauncus rounded-triangular. Suprarami present. Left uncus large, 3 enlarged and partly fused teeth, right uncus reduced to 2 diverging rod-shaped teeth. Left manubrium large, widening subdistally then strongly and smoothly curved to an angle of ~90°. Right manubrium rod-shaped. SEM pictures show a curved, elongate thread-like projection ventrally over the supraunci. The significance of this structure is unclear.

Measurements (all in μm): Body length (incl. foot), 189; trunk length, 160; width 49; foot length, 21; anterior spine length, 12.5 (proximal), 13.5 (distal); maximum keel height, 19.8; left toe spine length, 97-102; right toe spine length, 55. Trophi: total length, 51; left manubrium length, 36.5, right, 16.7; rami width, 25.0; left ramus length (incl. alulus), 27.0; right, 25.0; fulcrum, 34.9.

Etymology: The name of the new species is a noun in apposition, referring to the species' type locality.

Remarks: Information in the literature on *T. insignis* (Herrick, 1885) is, surprisingly, scanty, insufficiently detailed, and equivocal: drawings of the trophi by different authors (Wulfert 1956, Pourriot 1970, Chengalath and Mulamoottil 1975, De Smet 1989 1990) show markedly different structures, which can hardly be ascribed to differences in interpretation alone.

During this study it appeared that a diagnostic feature of *T. myersi* cited by Koste (1978), the shape of the suprarami, could not be confirmed as such. Suprarami appear to be present in all Trichocercidae studied so far. The orientation of the spine-shaped extensions of these is difficult to ascertain, and appears to depend on the observation angle.

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