

On two new species of *Proales* from France, with reallocation of *Dicranophorus liepolti* Donner, 1964 and *D. secretus* Donner, 1951 (Rotifera, Monogononta)

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ABSTRACT

Two new species of rotifer, *Proales ardechensis* n. sp. and *P. laticauda* n. sp. (Monogononta, Proalidae) from the Ardèche, France, are described and illustrated. *Proales ardechensis* n. sp. is readily distinguished from its congeners by the stout foot composed of 4 pseudosegments of which the penultimate one bears an antenna at its posterior margin dorsally, and the malleate trophi bearing characteristic hook-shaped alulae. *Proales laticauda* n. sp. is characterized by its broad and stout truncate tail almost overlying the foot, and its small and slender basally swollen toes. Based on the trophi morphology studied by scanning electron microscopy *Dicranophorus liepolti* Donner, 1964 is reallocated to the genus *Encentrum*, and *D. secretus* Donner, 1951 is placed in the genus *Aspelta*.

RÉSUMÉ

Sur deux espèces nouvelles de *Proales* de France, avec réinstallation de *Dicranophorus liepolti* Donner, 1964 et *D. secretus* Donner, 1951 (Rotifera, Monogononta).

Deux nouvelles espèces de rotifères, *Proales ardechensis* n. sp. et *P. laticauda* n. sp. (Monogononta, Proalidae), récoltées en Ardèche, France, sont décrites et illustrées. *Proales ardechensis* n. sp. se distingue nettement par son pied robuste composé de 4 pseudosegments dont l'avant-dernier porte une antenne près de son bord postérieur dorsal, et ses trophi mallées montrant des alulae spécifiques en forme de crochet. *Proales laticauda* n. sp. est caractérisée par sa large queue tronquée couvrant à peu près complètement le pied, et ses petits orteils sveltes aux bases gonflées. L'étude par microscopie électronique à balayage des trophi montre que *Dicranophorus liepolti* Donner, 1964 doit être transféré dans le genre *Encentrum*, et que *D. secretus* Donner, 1951 appartient au genre *Aspelta*.

MOTS CLÉS

Rotifera,
Monogononta,
Proalidae,
Proales,
Aspelta,
Encentrum,
Dicranophorus,
France,
taxonomie,
espèces nouvelles,
combinaisons nouvelles.

KEY WORDS

Rotifera,
Monogononta,
Proalidae,
Proales,
Aspelta,
Encentrum,
Dicranophorus,
France,
taxonomy,
new species,
new combinations.

INTRODUCTION

Proalidae Haring & Myers, 1924 is a small family of monogonont rotifers comprising four genera and 55 species considered valid, of which the genus *Proales* Gosse, 1886 (44 species) is the most species-rich (De Smet 1996; Segers 2007). Many more species definitely await description as they have been largely neglected because of their illoricate or only weakly stiffened integument, raising difficulties in obtaining well-preserved specimens. They moreover are often strongly similar in body shape, which led to superficiality and/or neglect of the study of the trophi which are species specific. Another problem poses their often fairly small dimensions through which light-microscopic observations of the trophi are highly deficient, and different species may well be hidden under the same name. During an ongoing study of the rotifers from the Ardèche, France we came across two hitherto unknown *Proales* species which are described in the present contribution. Samples from the same region also contained specimens of two taxonomically problematic members of the Dicranophoridae Haring, 1913, *Dicranophorus secretus* Donner, 1951 and *D. liepolti* Donner, 1964, the study of which enabled us to resolve the matter and reallocate them to the genus *Aspelta* Haring & Myers, 1928 and *Encentrum* Ehrenberg, 1838 respectively.

ABBREVIATIONS

ANSP Academy of Natural Sciences of Philadelphia;
 RBINS Royal Belgian Institute of Natural Sciences,
 Brussels;
 MNHN Muséum national d'Histoire naturelle, Paris;
 UA University of Antwerp, Department of Biology.

MATERIALS AND METHODS

The two new species of *Proales*, *Dicranophorus secretus* and *D. liepolti* were sampled near St-Julien-du-Serre, Ardèche, France. *Aspelta circinator* (Gosse, 1886) was collected in periphyton from the pond "Zwartwater", Turnhout, Belgium. Both live and fixed animals were studied. For fixation and preservation a ~4% formalin solution was used. Photographs of live specimens were obtained with a Leitz Ortholux

microscope equipped with a Canon S50. Animals were drawn using a Leitz Orthoplan microscope with camera lucida. Preparation of trophi for scanning electron microscopy (SEM) was done following De Smet (1998) using NaOCl solution to dissolve the tissues. For SEM a Philips SEM 515 microscope operated at 20 kV was used.

SYSTEMATICS

Phylum ROTIFERA Cuvier, 1812
 Class EUROTATORIA De Ridder, 1957
 Subclass MONOGONONTA Plate, 1889
 Order PLOIMA Hudson & Gosse, 1886
 Family PROALIDAE Haring & Myers, 1924
 Genus *Proales* Gosse, 1886

Proales ardechensis n. sp.
 (Figs 1; 2)

TYPE MATERIAL. — All specimens from the type locality, collected 24.III.2007 and 8.VII.2008.
 Holotype: ♀ in a permanent glycerine glass slide mount (RBINS IG31125, RIR194).
 Paratypes: 38 ♀♀; 1 ♀ each in glass slide mount (RBINS RIR195), ANSP (Reg. N° 1975) and MNHN (AM 878); 30 ♀♀ in glass slide mounts and 5 stubs each with one trophi preparation for SEM in UA.

TYPE LOCALITY. — Saint-Julien-du-Serre (4°25'0"E, 44°39'0"N), Ardèche, Rhône-Alpes, France.

ETYMOLOGY. — The species name *ardechensis* is derived from the area where the species was found.

DIAGNOSIS. — Stout fusiform animal with stout, long, c. 1/3 total length foot composed of four pseudosegments; penultimate foot pseudosegment with antenna dorsally near posterior margin. Pedal glands large with large reservoir, foot-length. Eyespots two colourless globules surrounded by dark-red granules, posteriorly between brain and mastax. Trophi malleate; rami with hook-shaped alulae; unci plate-shaped with 5 major teeth and 1-2/3 minor teeth.

DESCRIPTION OF FEMALE

Body broadly fusiform, stout (Fig. 1A, B). Head offset by neckfold; rostrum broad, short, truncate. Trunk ovate in dorsal view, offset from foot, in lateral view arched dorsally, more or less flattened

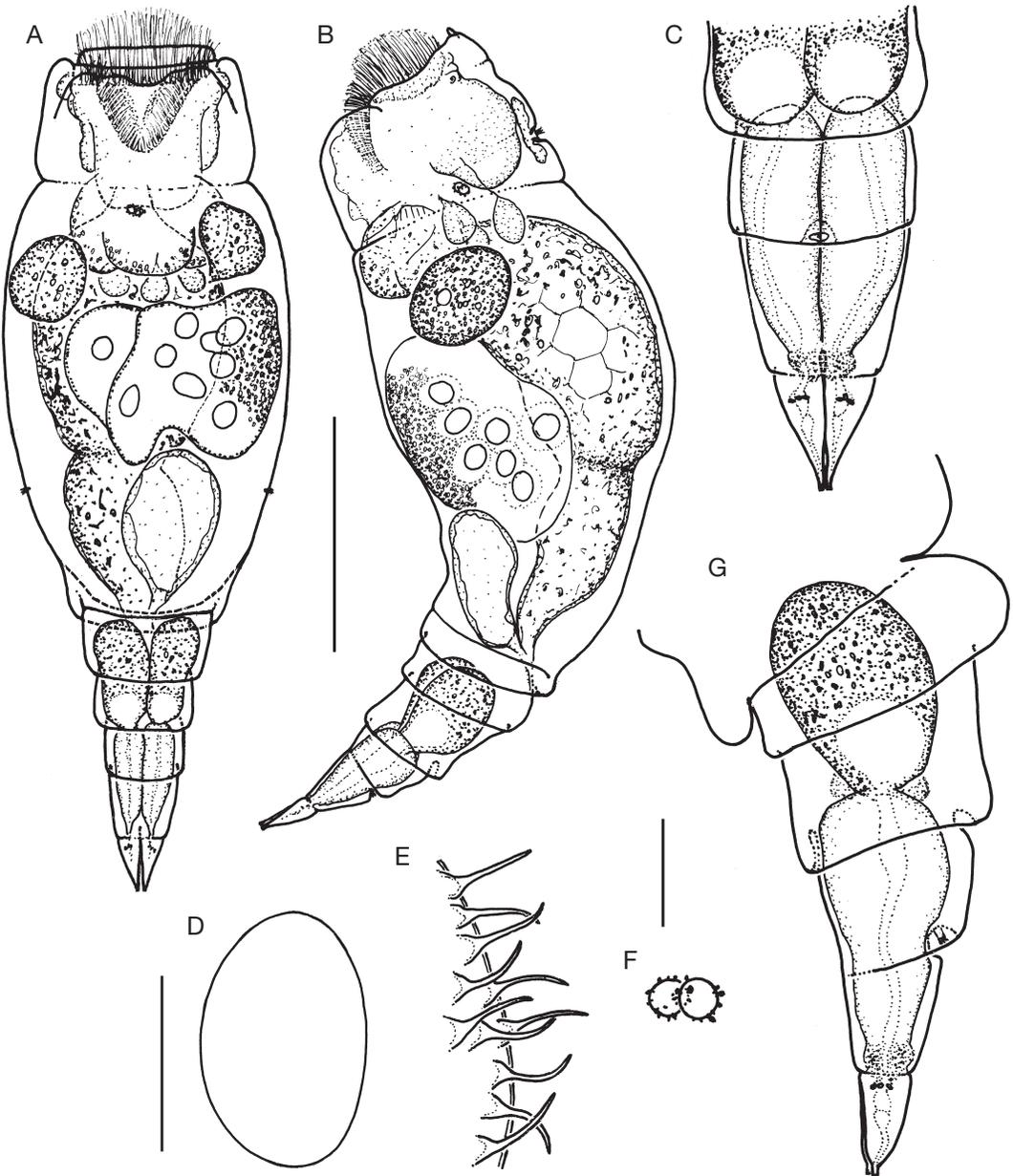


FIG. 1. — *Proales ardechensis* n. sp., female: **A**, ventral view; **B**, lateral view; **C**, detail of toes and distal foot pseudosegments, dorsal view; **D**, outline of resting egg, projections omitted; **E**, projections on resting egg; **F**, eyespots; **G**, foot, lateral view. Scale bars: A, B, D, 50 μ m; C, E-G, 10 μ m.

ventrally; a short distal pseudosegment. Tail broad, truncate, less prominent. Foot long, $c. \frac{1}{3}$ total length, stout, elongate conical; 4 pseudosegments, proximal

pseudosegment shortest, the others equally long; penultimate pseudosegment with antenna (Fig. 1G) dorsally near posterior margin (often covered by

posterior margin). Toes short, conical, very weakly decurved ventrally, appressed. Corona slightly oblique. Dorsal antenna near posterior third of head. Brain saccate. Retrocerebral sac absent. Subcerebral glands present. Eyespots (Fig. 1F) two colourless globules surrounded by a few dark-red granules, situated between brain and mastax, apparently not connected to posterior of brain. Between mastax and brain some individual cells apparently connected to brain. Lateral antennae small, near posterior third of trunk. Gastric glands large, spherical, latero-dorsal, ducts very short to absent. Stomach and intestine separated by shallow constriction. Pedal glands very large, ovate in lateral view, in dorsal/ventral view slightly compressed laterally, located in the two proximal foot pseudosegments, often extending into trunk, with large elongate reservoir in distal part of foot. Bladder normal. Vitellarium with eight nuclei.

Trophi malleate (Fig. 2). Incus almost perpendicular to body axis; axis of manubria parallel to body axis. Rami and fulcrum forming weak angle with each other; rami triangular with tips slightly recurved caudally, and an acute hook-shaped alula ventrally near lateral corner of rami; inner margins frontally with row of large projections, caudally a comb of appressed scleropili; basal apophyses a crest of appressed scleropili; fairly large triangular basifenestrae caudally, and large rounded sub-basifenestrae ventrally. Fulcrum half ramus length, plank-shaped, in lateral view parallel-sided, distal margin oblique bearing weakly developed basal plate. Unci a plate of firmly fused teeth; each uncus with 5 large teeth decreasing in size dorsally, and a set of 1 or 2 (left) or 3 (right) minor dorsal teeth; major teeth with small appressed preuncinal tooth; ventral margin of major tooth with small knob medially; subuncus a series of loosely bound scleropili. Manubria with well-developed, almost roundish head slightly longer than half manubrium length, showing 3 large openings, and stout, weakly curved shaft ending in slightly knobbed cauda. Epipharynx two ribbons of scleropili decreasing in length distally.

A single mictic female with resting egg inside was found in the sample of July. The resting egg (Fig. 1D, E) is more or less ellipsoid and ornamented all-over with spiniform projections.

Male unknown.

Measurements

Total length 150-230 μm (mean 184 μm , N=15), toe 9-12 μm (mean 10 μm); trophi (N=4): ramus 11.5-14.1 μm , fulcrum 7.2-9.4 μm , uncus 10.2-10.9 μm , manubrium 14.2-18.6 μm ; resting egg 72 \times 47 μm , spines 8-10 μm .

REMARKS

Although *Proales ardechensis* n. sp. keys out to *P. sigmoidea* (Skorikov, 1896) following the key by De Smet (1996), these two cannot be confused given the different trophi type: malleate in the new species and virgate in *P. sigmoidea*. Additionally the toes are conical in *P. ardechensis* n. sp. and more or less foliate in dorsal view in *P. sigmoidea*. The outer organization of *P. ardechensis* n. sp. resembles *P. similis* de Beauchamp, 1907, which however, has a single wrinkled foot pseudosegment without dorsal antenna, instead of four pseudosegments, the penultimate of which bearing an antenna dorsally. The trophi structure of both species is malleate, but *P. ardechensis* n. sp. differs mostly by its hook-shaped alulae situated just below the lateral ramus corners, different from the straight alulae set at some distance from the lateral ramus corners of *P. similis*. Additional differences in trophi structure are the manubria with the more or less rounded head of half manubrium length, and the weakly curved shaft with knobbed cauda (head elongate triangular, about $\frac{2}{3}$ manubrium length; shaft short with incurved cauda in *P. similis*), and the unci with 5 major teeth and 1-3 minor teeth (unci with 4 major teeth and 3 or 4 minor teeth in *P. similis*). Other species with similar external morphology, i.e. stout fusiform body with stout moderately long foot, are *P. daphnicola* Thompson, 1892 and *P. kostei* Nogrady & Smol, 1989, which however are unequivocally differentiated by the large characteristic basal rami apophyses.

ECOLOGY AND DISTRIBUTION

Proales ardechensis n. sp. was found in March and July, amongst wet mosses in the seepage area on a vertical rockface at a pH of 7.35 and water temperature of 7°C; the habitat usually dries up in summer. The accompanying rotifer fauna was dominated by bdelloids (*Adineta* sp., *Dissotrocha* sp., *Henoceros*

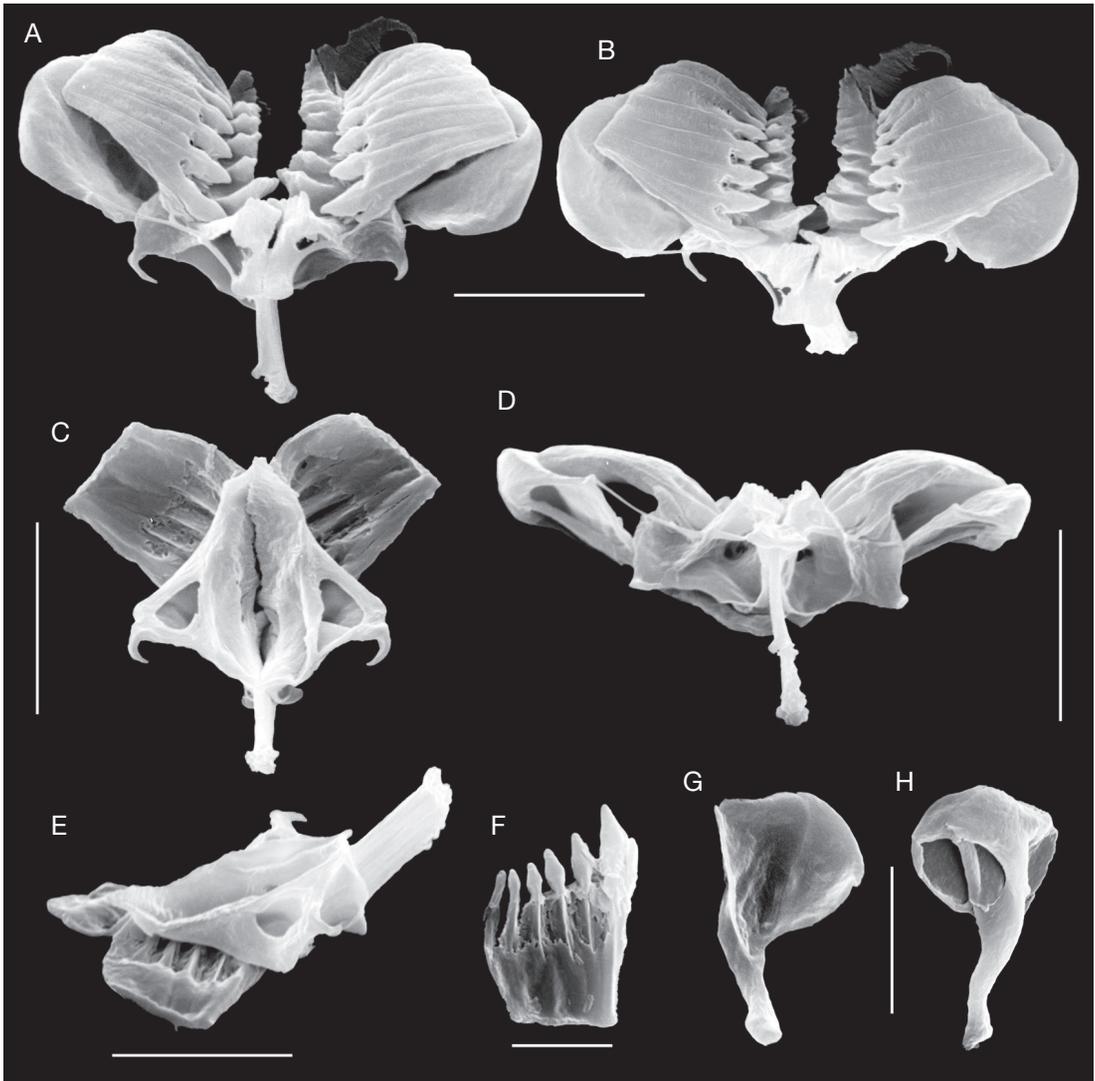


FIG. 2. — *Proales ardechensis* n. sp., SEM photographs of trophi: **A**, complete set, ventro-apical view; **B**, same as **A**, frontal view; **C**, incus dorso-caudal view; **D**, complete set, caudal view; **E**, incus lateral view; **F**, left uncus, inner view; **G**, left manubrium, inner view; **H**, left manubrium, outer view. Scale bars: **A-E**, **G**, **H**, 10 μ m; **F**, 5 μ m.

falcatus (Milne, 1916), *Pleuretra brycei* (Weber, 1898)); the monogononts belonged to *Cephalodella*, *Colurella*, *Lecane* and *Lepadella*.

The species has to date only been recorded from the type locality. All freshwater records of the superficially similar *P. similis*, which is an inhabitant of inland saline, marine and brackish waters, are doubtful and may concern *P. ardechensis* n. sp.

Proales laticauda n. sp.
(Figs 3; 4)

TYPES. — All specimens from the type locality and collected 12.V.2008.

Holotype: parthenogenetic ♀ in a permanent glycerine glass slide mount (RBINS IG31125, RIR196).

Paratypes: 16 ♀♀; 1 parthenogenetic ♀ each in glass slide mount in RBINS (Reg. N° RIR197), ANSP (1976) and

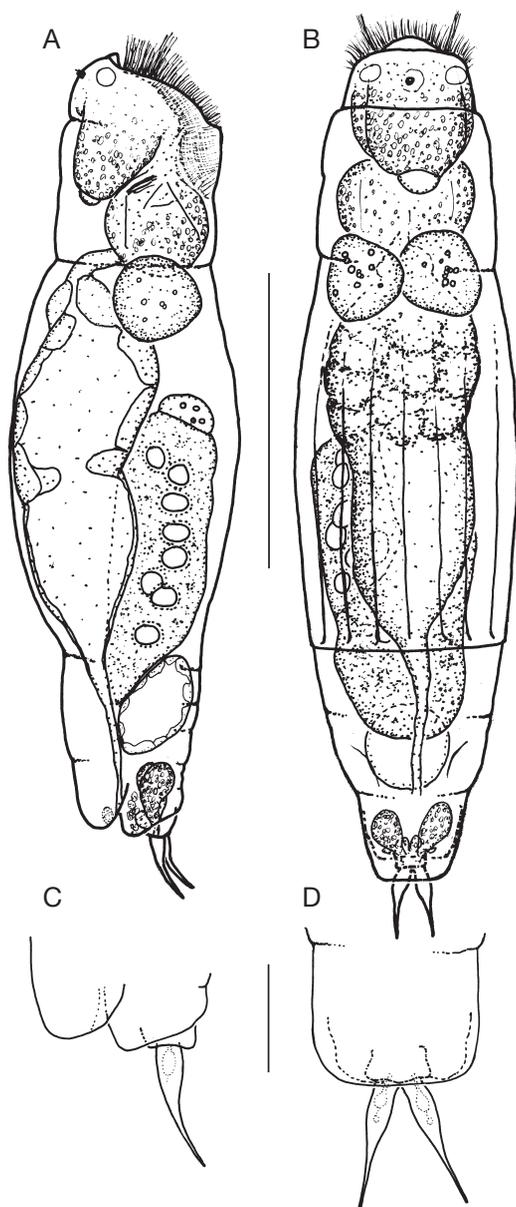


FIG. 3. — *Proales laticauda* n. sp., female: **A**, lateral view; **B**, dorsal view; **C**, detail of foot, toes and tail, lateral view; **D**, detail of foot, toes and tail, dorsal view. Scale bars: A, B, 50 μ m; C, D, 10 μ m.

MNHN (AM 879); 8 ♀♀ in slide mounts and 5 stubs each with one trophi preparation for SEM in UA.

TYPE LOCALITY. — Saint-Julien-du-Serre (4°25'0"E, 44°39'0"N), Ardèche, Rhône-Alpes, France.

ETYMOLOGY. — The species name *laticauda* is derived from the Latin adjective *latus*, broad, and the noun *cauda*, tail, in reference to the large tail.

DIAGNOSIS. — Body cylindrical; foot short, two pseudosegments, almost completely covered by large and broad truncate tail. Toes small and slender, swollen basally. Trophi malleate; rami with short spiniform alulae; unci plate-shaped with 4 or 5 major teeth and 1-3 minor teeth.

DESCRIPTION OF FEMALE

Body (Fig. 3A, B) almost cylindrical in dorsal view, in lateral view dorsal and ventral margin of trunk weakly arched. Head offset by neckfold; rostrum small, rounded; a transversal dorsal fold at 1/3 from top. Trunk long, without obvious pseudosegments except for its distal part; anterior 2/3 with faint longitudinal folds dorsally. Tail (Fig. 3C, D) large and broad, truncate distally, almost covering foot completely. Foot with very small and narrow distal pseudosegment and a much broader penultimate pseudosegment. Toes very small, swollen till mid-length, narrowing and tapering afterwards, in lateral view weakly decurved ventrally. Corona oblique, two small lateral tufts of longer cilia. Dorsal antenna medially on first head pseudosegment. Brain saccate. Retrocerebral sac small, clear. Two colourless globules (eyespot?) laterally at base of rostrum. Lateral antennae not seen. Mastax spherical. Stomach cellular, separated from intestine by constriction; a small proventriculus present. Gastric glands large, spherical, ducts apparently absent. Pedal glands small, club-shaped. Bladder normal. Vitellarium with 8 nuclei.

Trophi malleate (Fig. 4). Incus almost perpendicular to body axis; axis of manubria parallel to body axis. Rami and fulcrum forming weak angle with each other. Rami triangular, tips weakly recurved caudally, short spiniform alulae somewhat ventrally below lateral rami corners; inner margins with row of stout projections frontally; basal apophyses a crest of stout appressed scleropili; basifenestrae caudal, triangular; sub-basifenestrae ventral, rounded, moderately large. Fulcrum fairly long, in lateral view tapering distally. Unci a plate of firmly fused teeth; each uncus with 4 or 5 large teeth decreas-

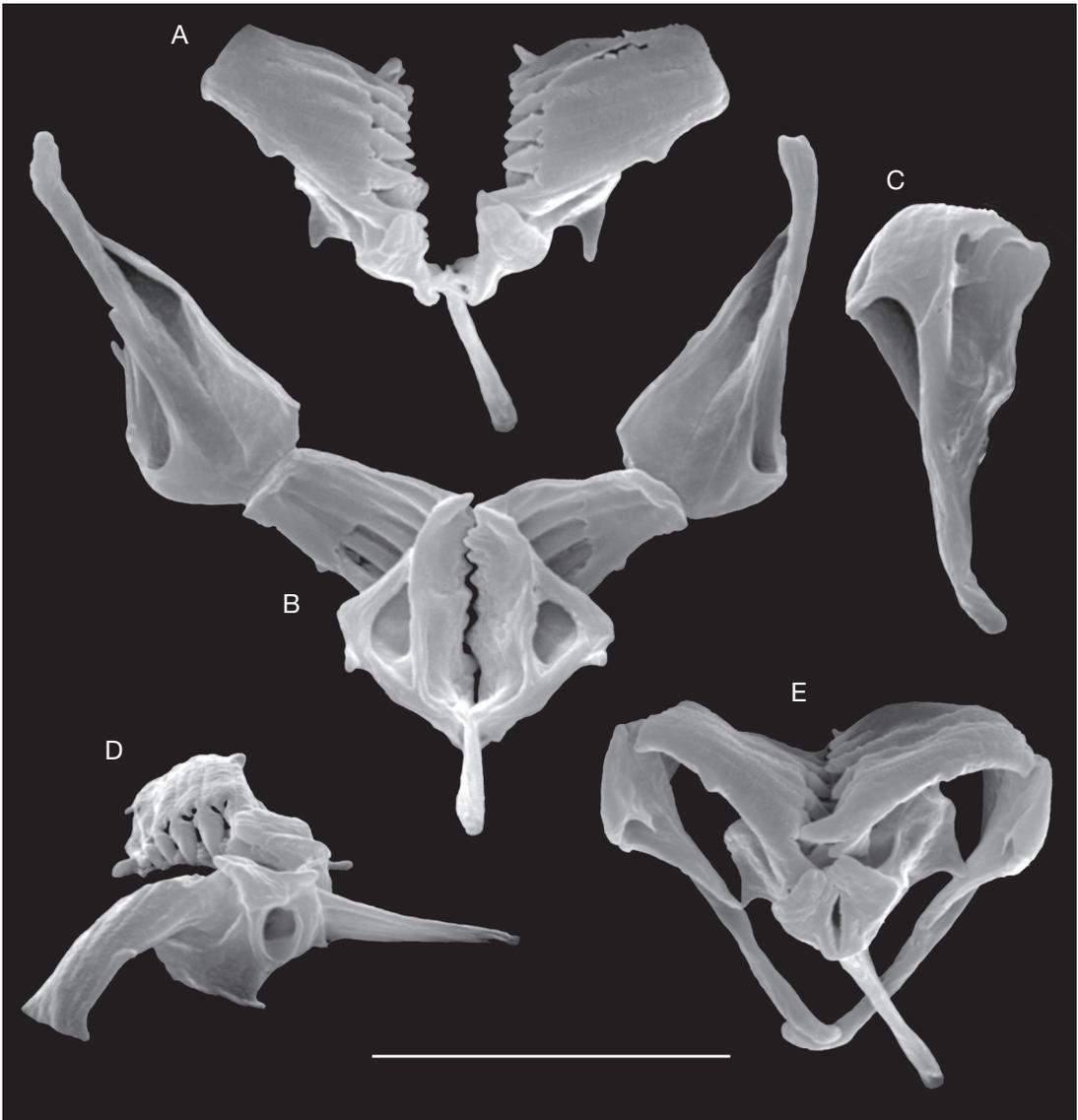


FIG. 4. — *Proales laticauda* n. sp., SEM photographs of trophi: **A**, incus and unci, frontal view; **B**, complete set, incus dorso-caudal view, manubria and unci inner view; **C**, left manubrium, outer view; **D**, incus and unci, lateral view; **E**, complete set, ventro-apical view. Scale bar: 10 μ m.

ing in size dorsally, and set of 1-3 (left) or 1 or 2 (right) minor dorsal teeth; major teeth with a small preuncinal tooth and a small knob at $\frac{1}{3}$ of ventral margin; head of major teeth distinctly offset with small lateral knobs at base. Manubria with long

triangular head, short shaft and weakly incurved cauda; dorsal opening of head small, medial and ventral openings large. Epipharynx two long, distally tapering ribbons of appressed scleropili.

Male unknown.



FIG. 5. — *Aspelta secreta* (Donner, 1951) n. comb., female: **A**, dorsal view; **B**, detail of head with rostral appendage.

Measurements

Total length 113–141 μm (mean 130 μm , $N=15$), toe 11–14 μm (mean 12 μm); trophi ($N=3$): ramus 7.0–7.2 μm , fulcrum 5.6–6.3 μm , uncus 6.9–7.7 μm , manubrium 10.6–12.3 μm .

REMARKS

Proales laticauda n. sp. can hardly be confused with any congener. Applying the key by De Smet (1996) and assuming that the colourless globules at the base of the rostrum are eyespots, the new species does not key out. On the other hand, accepting that eyespots are absent leads to *P. cryptopus* Wulfert, 1935 and *P. macrura* Myers, 1933. Both species have a cylindrical body and large tail covering foot and toes completely or almost completely. The large (375 μm) *P. cryptopus* differs from the smaller (~130 μm) *P. laticauda* n. sp. by the very short (1/34 total length) conical toes (toes small, swollen till mid-length, tapering distally in *P. laticauda* n. sp.), the elongate gastric glands with acute ends (glands spherical in *P. laticauda* n. sp.) and the red cerebral eyespot (?eyespots absent or two colourless rostral globules in *P. laticauda* n. sp.). The likewise small (150 μm) *P. macrura* is distinguished from the new species by the almost ventral corona (corona oblique in *P. laticauda* n. sp.), the cerebral eyespot, the ventrally placed tubular foot (foot with small distal and broad penultimate pseudosegment in *P. laticauda* n. sp.), and short toes with slightly swollen bases. Both *P. cryptopus* and *P. macrura* have malleate or

modified malleate trophi differing from those of *P. caudata* n. sp., but lack of detail of the descriptions and figures based on light-microscopic observations do not allow for a direct comparison.

ECOLOGY AND DISTRIBUTION

Proales laticauda n. sp. was collected in a fire-wood from aerophytic moss growing on sandstone. It was accompanied by *Mniobia* sp., *Habrotrocha* sp. and other unidentified bdelloids, and the monogononts *Aspelta secreta* and *Colurella* sp. To date the new species has only been recorded in May from the type locality.

Family DICRANOPHORIDAE Harring, 1913

Aspelta secreta (Donner, 1951) n. comb. (Figs 5; 6)

Dicranophorus secretus Donner, 1951: 636, fig. 24a-e; 1964: 283, fig. 19a-d. — Koste 1976: 205, pl. 9, fig. 2a, b.

NEOTYPE. — A female in a permanent glycerine glass slide preparation deposited in MNHN (AM 880). Additional type material: four stubs with one trophi preparation each for SEM in UA.

MATERIAL EXAMINED. — **France**. Rhône-Alpes, Ardèche, vegetation in a spring near river Louyre, 22.IV.2008, 5 ♀♀.

DESCRIPTION OF TROPHI (FIG. 6)

Trophi forcipate, weakly asymmetrical. Rami outline pear-shaped; median rami opening small, slit-shaped

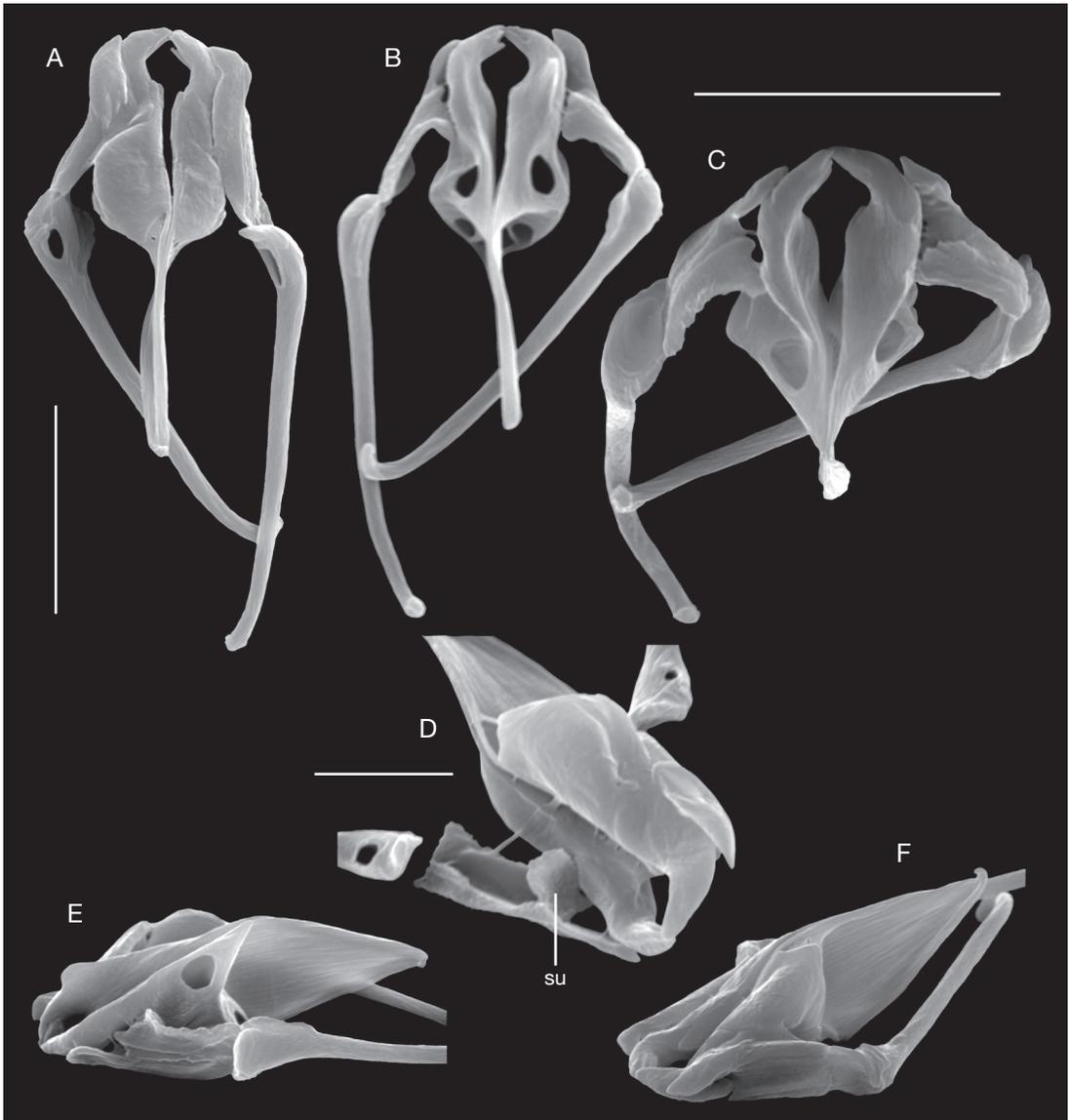


FIG. 6. — *Aspelta secreta* (Donner, 1951) n. comb., SEM photographs of trophi: **A**, complete set, ventral view; **B**, complete set, dorsal view; **C**, same as B, dorso-frontal view; **D**, detail, rami and left uncus, oblique view; **E**, incus and uncus, left dorso-lateral view; **F**, incus and uncus, right ventro-lateral view. Abbreviation: **su**, subuncus. Scale bars: A-C, E, F, 10 μ m; D, 5 μ m.

proximally and rounded distally, transition from slit to rounded part more or less angular; outer margin of rami weakly concave; right ramus of stouter build, terminating in blunt incurved tip, with small crest at base of tip; incurved tip of left ramus

with 3 or 4 small teeth; the sub-basal chambers are flattened laterally, forming lamellar rounded alulae displaying a rounded opening; basal chambers with rounded opening proximally. Fulcrum rod-shaped in dorsal/ventral view, in lateral view elongate-

TABLE 1. — Comparative measurements (μm) of trophi elements in *Aspelta* spp. Abbreviations: **Ave**, average; **N**, number.

	<i>A. circinator</i>			<i>A. curvidactyla</i>			<i>A. secreta</i>		
	Length	Ave	N	Length	Ave	N	Length	Ave	N
Ramus	9.7-11.2	10.7	4	7.1-9.0	8.5	3	10.6-11.4	11.1	4
Fulcrum	9.2-9.6	9.3	4	7.0-8.0	7.6	4	8.4-9.7	9.1	4
Uncus, left	8.3-8.4	8.3	3	7.1-8.0	7.6	3	8.4-9.1	8.8	4
Uncus, right	7.5	7.5	3	6.1-6.9	6.6	3	8.0-8.4	8.2	4
Manubrium, left	18.3-20.0	19.2	4	16.5-18.0	17.5	4	20.3-20.5	20.4	4
Manubrium, right	18.0-19.6	19.1	4	16.0-17.6	17.1	4	19.7-20.0	19.9	4

triangular, slightly less ramus length. Unci more or less symmetrical, each composed of long ventral tooth resting on the ventral side of the ramus, and a shorter median tooth with dorsal prominence resting latero-ventrally on the ramus; subuncus (Fig. 6D: su) an U-shaped platelet. Manubria incus length, straight or very weakly undulate, incurved distally, head weakly expanded with inwardly directed projection and small opening.

Measurements of trophi: see Table 1.

REMARKS

Koste (1976) stressed the great similarity of the trophi of *Dicranophorus secretus* with these of the genus *Aspelta*, and points out (Koste 1978) its resemblance with *A. circinator* (Gosse, 1886). Awaiting for further study, De Smet (1997) left the species, with several others, in the genus *Dicranophorus* although regarded their position therein as by no means certain. The examination of the trophi of specimens fully agreeing with the species described by Donner (1951) under *Dicranophorus secretus* (Fig. 5), and characterized by a head with broad rostrum bearing typical lateral angular prominences, shows that their morphology is identical to that of genus *Aspelta*. Besides this similarity of the trophi, there is also an obvious similarity in the external and internal organization of the body. Given this overall similarity and seeing that trophi morphology is the most important character in the establishment of genera in Dicranophoridae (see e.g., De Smet 1997), the species should be reallocated to the genus *Aspelta*.

Comparison of the trophi of the different *Aspelta* species shows that *A. secreta* n. comb. is most closely related to *A. circinator* (Fig. 7) and *A. curvidactyla*

Bērziņš, 1949 (see SEM of trophi pl. 15 in De Smet [1997]). The trophi structure of these species as revealed by SEM is basically identical, apart from minor differences in dimensions (Table 1): trophi elements appear somewhat longer in *A. secreta* n. comb. and the smallest in *A. curvidactyla*, with intermediate values for *A. circinator*. However, measurements are based on a small number of specimens and insignificant statistically. The prominence at the inner margin of the right ramus near the base of the anterior part of the median rami opening, considered specific for *A. curvidactyla*, is merely a quantitative character, as SEM reveals that it is present in the other two species as well. Such a prominence, likewise present on the left ramus, proves to be the distal part of the sub-basal rami chambers that slightly projects in the median rami opening. The three species cannot be discriminated unequivocally on basis of their general external and internal morphology of the body and shape of the toes; length of body and toes are similar as well. Only two external diagnostic features allow for some differentiation: the rostrum is small and rounded in *A. circinator* and *A. curvidactyla*, and broad with lateral triangular lamellae in *A. secreta* n. comb.; two tentacles laterally from the rostrum are apparently present in *A. curvidactyla* only. *Aspelta circinator* has two minute colourless eyespots at the base of its rostrum, whereas eyespots are absent, although they may have been overlooked, in the other two species. Considering these minor differences in morphology of the body and trophi between *A. circinator*, *A. curvidactyla* and *A. secreta* n. comb., the question arises whether we are dealing with valid morphospecies or mere morphological variability of a single species. Since the application

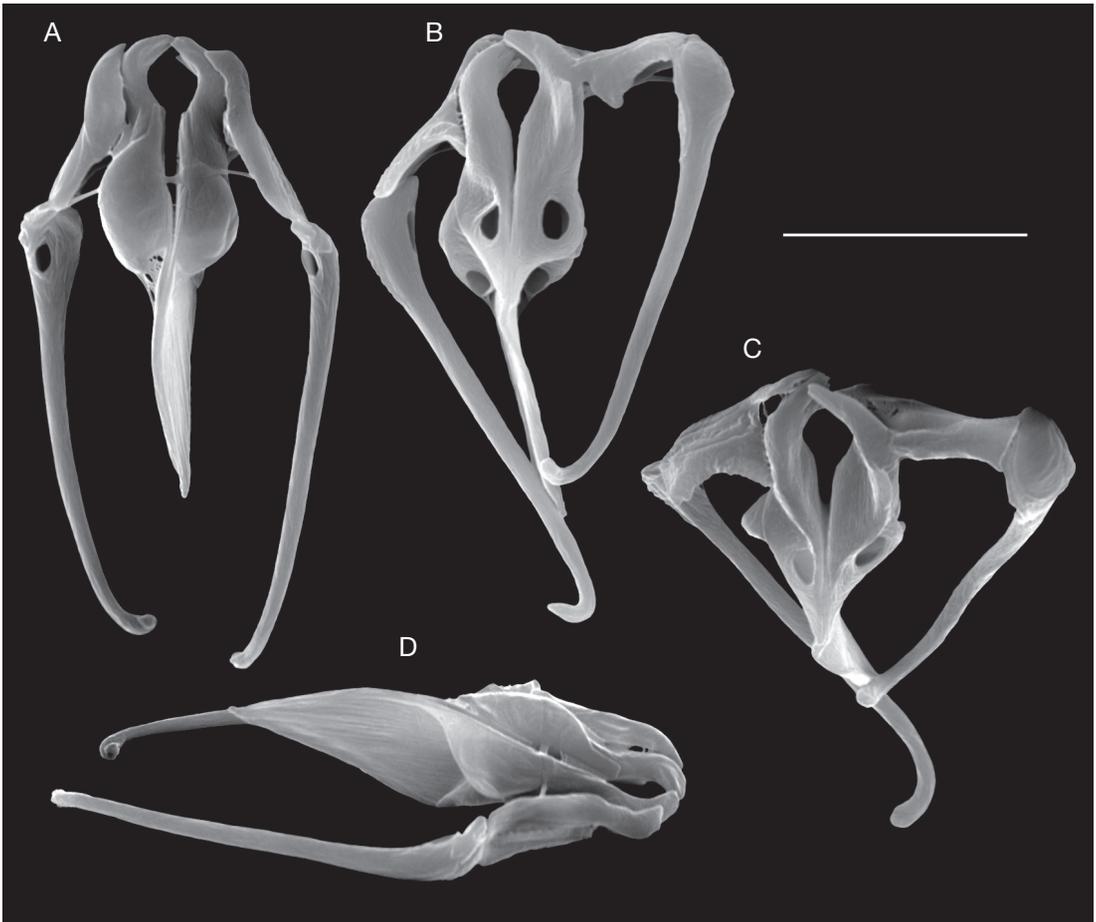


FIG. 7. — *Aspelta circinator* (Gosse, 1886), SEM photographs of complete set of trophi: **A**, ventral view; **B**, dorsal view; **C**, dorso-frontal view; **D**, lateral view. Scale bar: 10 μ m.

of molecular techniques, there is increasing evidence of the commonness of cryptic species complexes (e.g., Gómez *et al.* 2002; Gilbert & Walsh 2005; Schröder & Walsh 2007), showing that rotifer diversity is largely underestimated. Morphological differences between cryptic species, if any, are minute or taxonomically unreliable because of large overlap (e.g., Campillo *et al.* 2005; Fontaneto *et al.* 2007), or restricted to the surface structure of the diapausing eggs (e.g., Schröder & Walsh 2007). Molecular investigations are needed to confirm the reliability of the delineations of *A. circinator*, *A. curvidactyla* and *A. secreta* n. comb. on the ba-

sis of morphology. This also holds for two other *Aspelta* species, *A. psitta* Haring et Myers, 1928 and *A. bidentata* Wulfert, 1961, apparently differing only in the shape of the rostrum.

Aspelta circinator, *A. curvidactyla* and *A. secreta* n. comb. key out sub *A. curvidactyla* in the key by De Smet (1997).

Aspelta secreta n. comb. is a widespread species known from Europe, the Eastern Mediterranean and Madagascar (De Ridder & Segers 1997; Segers 2007), inhabiting leaf litter, limnopsammon, aerophytic mosses and mosses of stagnant and running waters. There is a single record from France by Pourriot



FIG. 8. – *Encentrum liepolti* (Donner) n. comb., female: **A**, lateral view; **B**, foot and toes, with joint indicated (arrow); **C**, same as B, with kinked claw.

(1965), who found the species in a sphagnum bog at Grandvaux, near Brinon-sur-Sauldre, Cher. It is a voracious species preying on other rotifers. The gut content of the animals studied contained *Cephalodella* sp., *Colurella uncinata* (Müller, 1773), *Lecane* sp. and *Lepadella* spp.

Encentrum liepolti (Donner, 1964) n. comb.
(Figs 8; 9)

Dicranophorus liepolti Donner, 1964: 281-283, fig. 18a-k.

NEOTYPE. — A female in a permanent glycerine glass slide preparation deposited in MNHN (AM 881). Additional type material: 9 females in slide mounts and 7 stubs each with trophi preparation for SEM in UA.

MATERIAL EXAMINED. — **France**. Rhône-Alpes, Ardèche, St-Julien-du-Serre, below outflow of spring “Source Jumel”, 25.V.2006, water temperature 13°C, pH 8.23, 17 ♀♀.

DESCRIPTION OF TROPHI (FIG. 9)

Trophi forcipate. Rami outline more or less hexagonal; rami opening more or less mushroom-shaped; rami broad, each with long drawn out and inwardly kinked dorsal apical ramus tooth, and a straight and shorter ventral apical ramus tooth (Fig. 9C: at);

latero-ventrally at the base of the dorsal apical ramus teeth is a socket (Fig. 9C: s) wherein the base of the preuncinal teeth is articulating; rami mainly connected to fulcrum by basal chambers. Sub-basal chambers with rounded alula postero-laterally; their inner margins with long plate-shaped part extending beyond inner margins of basal chambers; oval sub-basifenestrae caudally. Basal chambers each with large drop-shaped fenestra dorso-caudally. Fulcrum very long, longer than rami, in lateral view straight, with broader basal part, gradually tapering distally. Unci single with well-developed head and shaft bearing ventral and dorsal rib, and a dorsally appressed (Fig. 9G, H, J: vt), rod-shaped element (vestigial uncus tooth?); head with small basal knob and rib at the inner side. Preuncinal teeth composed of two fused elements consisting of tooth and shaft. Intramallei short, quadrangular with inwardly directed projection bearing supramanubria; at the base of the spine is a caudal opening. Supramanubria L-shaped. Manubria somewhat longer than incus, rod-shaped, in dorsal/ventral view incurved posteriorly, cauda crutched, head triangular with opening at inner side.

Measurements (N=5): ramus 6.0-8.9 µm, fulcrum 8.3-9.4 µm, 4.0-6.3 µm, manubrium 15.7-



FIG. 9. — *Encentrum liepolti* (Donner, 1964) n. comb., SEM photographs of trophi: **A**, complete set, ventral view; **B**, rami, dorsal view; **C**, incus, ventral view; **D**, complete set, ventro-frontal view; **E**, same as D, lateral view; **F**, right manubrium; **G**, right uncus, outer view; **H**, left uncus, lateral view; **I**, same as H, inner view; **J**, left uncus, outer view; **K**, right preuncus teeth, lateral view; **L**, same as K, oblique inner view; **M**, left preuncus teeth, lateral view; **N**, supramanubria; **O**, right intramalleus, inner view; **P**, same as O, outer view. Abbreviations: at, apical ramus teeth; s, socket for preuncus teeth; vt, vestigial tooth. Scale bars: A, 10 μ m; B-F, 5 μ m; G-P, 1 μ m.

17.1 µm, preuncinal tooth 3.2-3.8 µm, intramalleus 1.6-2.4 × 2.8-3.9 µm, supramanubrium 2.6-4.0 × 2.2-3.0 µm.

REMARKS

Donner (1964) probably assigned the species to the genus *Dicranophorus* because of its long toes, as was common practice formerly. However, the feature length of toes is a variable character and taxonomically irrelevant, as holds for several other rotifer genera. Jersabek (1994) stresses that several species with intramallei, and among them *D. liepolti*, have been incorrectly assigned to *Dicranophorus*. In his revision of the Dicranophoridae, De Smet (1997) considered the species *incertae sedis* in view of the presence of intramallei, a major character of the genus *Encentrum*. The results of the analysis of the trophi by SEM allows the reallocation of *D. liepolti* in the genus *Encentrum*.

The original description of the morphology of the body of the female (Fig. 8A) is fairly accurate, except for the toes which show a joint at 1/3 from the tip forming claw, not mentioned by Donner (1964) (Fig. 8B, C).

The trophi of *Encentrum liepolti* appear fairly derived, and due to their particular morphology, the species cannot be related to any other congener. It is distinguished by the very long fulcrum; the connection of the rami with the fulcrum which is mainly by the basal chambers and not by the sub-basal chambers as in the other *Encentrum* species studied by SEM so far (see e.g., De Smet 1997); the preuncinal teeth composed of a pair of fused teeth articulating with the rami by a rami cavity, instead of singular preuncinal teeth more or less firmly attached or fused to the rami ventrally; the alulae present on the subbasal chambers (alulae only reported in the insufficiently described *E. asellicola* (Bartoš, 1947) and in *E. frenoti* De Smet, 2002; the alulae in *E. frenoti* and the angular postero-lateral corners, which could be interpreted as alulae, as found in *E. kulmatyckii* Wiszniewski, 1953 and members of the subgenus *Encentrum* always form part of the basal chambers; the single alula in *E. kutikovae* De Smet & Chernyshev, 2006 is part of an accessory right ramus chamber intercalated between the basal and sub-basal chambers; the implantation of

the single alula on the right ramus in *E. ussuriensis* De Smet & Chernyshev, 2006 is unclear).

To date *E. liepolti* was only found in Austria, Europe, among submerged vegetation and both at the surface and in the bed sediments of running waters (De Ridder & Segers 1997; Segers 2007). It belongs to the dominant species of the hyporheic zone (Schmid-Araya 1998).

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