

*ENCENTRUM ESSEXIS* SP. N.  
(MONOGONONTA: DICRANOPHORIDAE), A NEW ROTIFER  
INHABITING STREAM BENTHOS FROM EAST ENGLAND

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A new species of Rotifera belonging to the genus *Encentrum* (Monogononta, Dicranophoridae) is described from benthos of the Blackwater River, East Anglia, Essex, England, UK. *Encentrum essexis* sp. n. is characterised by the in dorsal view more or less conical toes having three elongate drop-shaped, light-refracting bodies leading to the tip of the toe. Trophi of *Isoencentrum*-type; outline of rami hexagonal; intramallei extended towards trophi axis into long spiniform process; inner margin of basal rami chambers with short tooth.

Key words: Rotifera, taxonomy, Dicranophoridae, *Encentrum*, new species, stream benthos.

## INTRODUCTION

The family Dicranophoridae (Rotifera) is a large family of Monogononta rotifers, comprising 225 valid morphospecies (DE SMET 1997, unpubl.; SEGERS 2007). The earlier work of WISNIEWSKI (1937) reported that the family of Dicranophoridae contributed with 23.7% markedly to the overall rotifer species richness among assemblages inhabiting the interstices of sandy shores of lakes (psammon). Similarly, a later review by SCHMID-ARAYA (1998a) on interstitial rotifers from freshwater and marine psammon as well as riverine habitats concluded that Dicranophoridae contributed with 17.4% to the total rotifer diversity.

On the other hand, nearly half (105 species) of the Dicranophoridae species listed worldwide belong to the genus *Encentrum*. In general, the genus is cosmopolitan (SEGERS 2008) with aquatic habitat requirements of a generalist that occurs in any benthic, interstitial and/or periphytic habitat of freshwater and marine environments (e.g. PEJLER & BĚRZINŠ 1993, DE SMET 1997, FONTANETO *et al.* 2006, 2008). In lakes, species of the genus *Encentrum* are mostly found in littoral habitats (e.g. JERSABEK 1994, 1998, 1999) while in rivers and streams several species occur within the interstitial sediments even in sediment depths of up to 40 cm (SCHMID-ARAYA 1993, 1998b).

So far, only scarce information is available on the rotifer species diversity of streambeds since they are often treated just as a coarse taxonomic group,

and detailed information on their spatiotemporal distribution is rare as well (but see SCHMID-ARAYA 1998b).

During a survey to assess the benthic invertebrate diversity of the River Blackwater at Kelvedon (Essex, UK) we found a new species of *Encentrum* which is described hereafter.

## MATERIAL AND METHODS

General characteristics of the study site. The River Blackwater rises in northwest Essex (as the River Pant) and reaches the North Sea west of the town of Maldon, Essex in the East of England, UK. The catchment geology consists of London clay and glacial deposits of chalky boulder clay, sand and gravel (EMMERSON *et al.* 1997). Because the Blackwater River drains agricultural and horticultural landscapes, its immediate riparian vegetation varies accordingly. Upstream the River Pant where the river is less impacted, its riparian vegetation is dominated by oak (*Quercus robur*) and ash (*Fraxinus excelsior*) (REISS & SCHMID-ARAYA 2008). Due to the residential and agriculture settings, the stream is rich in nitrate (50–125 mg L<sup>-1</sup>) and phosphate (2–3 mg L<sup>-1</sup>). The Blackwater was designated as a sensitive area in terms of nitrate under the European Commission Nitrates Directive (ENTEC *et al.* 2007).

Sampling site. The new species of *Encentrum* was found within the downstream reaches (freshwater) of the River Blackwater near Kelvedon (51°50'0"N, 0°43'0"E). These reaches are classified as eutrophic, based on the annual mean of orthophosphate >100 µg P L<sup>-1</sup>, an annual mean of chlorophyll a >25 µg L<sup>-1</sup> and high percentage cover of the alga *Cladophora* (ENTEC *et al.* 2007). The streambed at the sampling locality is constituted by a mixture of grain-sizes with a median particle size in the armour layer (upper 5–10 cm) of 8 mm with upper and lower quartile values of 3.25 and 11.00 mm, respectively (SCHMID & SCHMID-ARAYA unpubl.). At the sampling site, mean water temperature for January and February 2000 was 6.1°C (SE±0.29), while water conductivity was 730 µS cm<sup>-1</sup> (SE±26.46) and pH was 7.0 (SE±0.2).

Sample collection and treatment. Benthic samples of all invertebrates were collected randomly using a modified Hess sampler between January and February 2000. The streambed sediments, contained within the area of the Hess sampler (sampling area: 179.1 cm<sup>2</sup>, mesh aperture 42 µm), were carefully stirred for 4 minutes to a depth of 5 to 10 cm. This process dislodges organisms that are clinging to stones and washes them into the sampler's net and container. Samples were poured into plastic containers and transported as live material to the lab. In the laboratory, samples were sieved live through a 500 µm mesh net and then one of 42 µm, and, thus, separated into meio- and macrofaunal fractions. Samples were processed removing all invertebrates from the sediments under a dissecting microscope.

Specimens of the new species were examined and drawn using a Leitz Orthoplan microscope equipped with a camera lucida. The preparation of trophi for light and scanning electron microscopy (SEM) was done following DESMET (1998), using a NaOCl solution to dissolve the soft parts. SEM was performed with a Philips SEM 515 microscope operated at 20 kV.

## RESULTS

### ***Encentrum essexis* sp. n.** (Figs 1–13)

Type locality. Blackwater River catchment (Kelvedon, Essex, East Anglia, England, UK).

Holotype. A parthenogenetic female in a permanent, glycerine glass slide mount deposited in the Royal Belgian Institute of Natural Sciences, (R.B.I.N.), Brussels. Reg. N°. IG 32585, RIR 213.

Paratypes. One slide with paratype, and a trophi preparation mounted in Faure, in R.B.I.N Reg. N°. IG 32585, RIR 214. Three other slides with parthenogenetic females and two stubs with trophi preparations for SEM in the Department of Biology, University of Antwerp.

Diagnosis. A medium-sized ( $\pm 170 \mu\text{m}$ ) *Encentrum*. Corona ventral, small. Toes more or less conical in dorsal/ventral view, with three elongate drop-shaped light refracting bodies leading to tip of toe (secretion reservoirs?); a weakly indicated transversal fold at 1/3 from tip. Trophi of *Isoencentrum*-type, outline of closed rami hexagonal. Inner margin of subbasal rami chambers with short tooth. Intramallei extended towards trophi axis into long spiniform process. Each ramus with two large preuncinal teeth.

Etymology. The species name *essexis* is a latinization of the type locality, Essex, as a noun in the genitive case.

Description. Parthenogenetic female. Body (Figs 1, 2) stout, fusiform, broadest at c. 1/3 from anterior margin in dorsal view. Cuticle smooth, not sticky. Head short, c. 1/6 of total length, very slightly tilted ventrally, two transversal dorso-lateral folds distally; rostrum small, broadly rounded; neckfold apparently absent; dorsal antenna near middle of head. Corona small, ventral. Trunk apparently without pseudosegments; in lateral view arched dorsally, highest in anterior half, almost straight ventrally or the narrower distal part slightly decurved ventrally; tail inconspicuous; lateral antennae in distal 1/3 of trunk. Foot short, with large proximal, and short distal pseudosegment. Toes (Figs 3–5) short, c. 1/18 of total length, with reservoirs in distal foot pseudosegment; more or less conical in dorsal/ventral view, terminating in distinct tubuli; in lateral view with slightly decurved dorsal margin and weakly indented ventral margin; bases of toes set close together; each toe with three elongate drop-like, light-refracting structures with tiny 'canal' leading to tip (secretion reservoirs?).

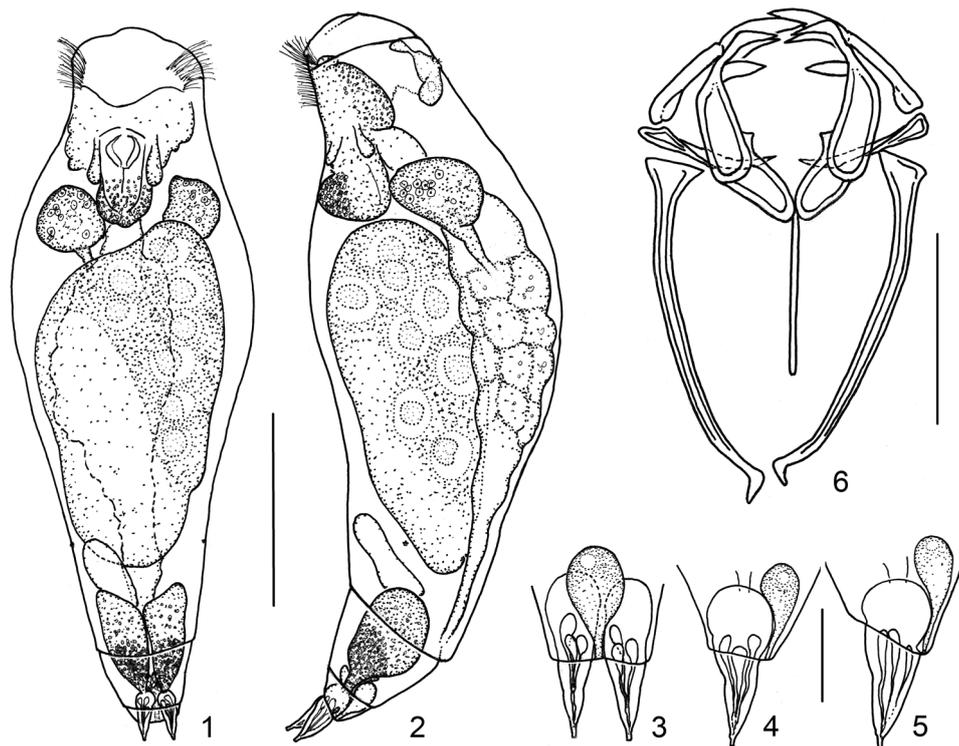
Eyespot(s) apparently absent. Brain fairly small, saccate; subcerebral glands present. Proventriculus present. Gastric glands rounded, large, stalks medium long. Bladder normal. Pedal glands very large, extending into trunk, oval in lateral view, in dorsal/ventral view with oblique proximal margin, distal part with distinct granules; two small accessory gland-like structures medio-ventrally. Foot distally with single medio-dorsal sensory cell of caudal antenna. Vitellarium with 8 nuclei.

Trophi (Figs 6–13). Rami outline hexagonal. Median rami opening broadly wedge-shaped. Rami stout, each with a slender, offset and incurved apical tooth; inner margin of subbasal rami chambers with short tooth distally; basifenestrae small, subbasifenestrae

large. Two preuncinal teeth of more stronger built than apical ramus teeth; outer margin of the ventral preuncinal teeth continuous with the rami outline, the dorsal ones placed at a right angle to the trophi axis; ventral preuncinal teeth with cardal apophysis. Fulcrum slightly shorter than rami, narrow and parallel-sided in dorsal/ventral view, in lateral view with broad base, gradually tapering distally, slightly decurved ventrally. Unci single-toothed, tooth slightly shorter than shaft, expanded in the dorso-ventral plane; dorsal apophyses well developed; shafts distally with distinct dorsal expansion. Intramallei (Fig. 13) more or less trapezoid in lateral view; anterior margin with two broad and fairly shallow apophyses; medial margin ventrally with distal part extended into long spiniform process pointing to the trophi axis. Supramanubria narrow, tips recurved rostrally. Manubria incurved in three weak steps; cauda with small crutch; head with triangular expansion and opening.

Male unknown.

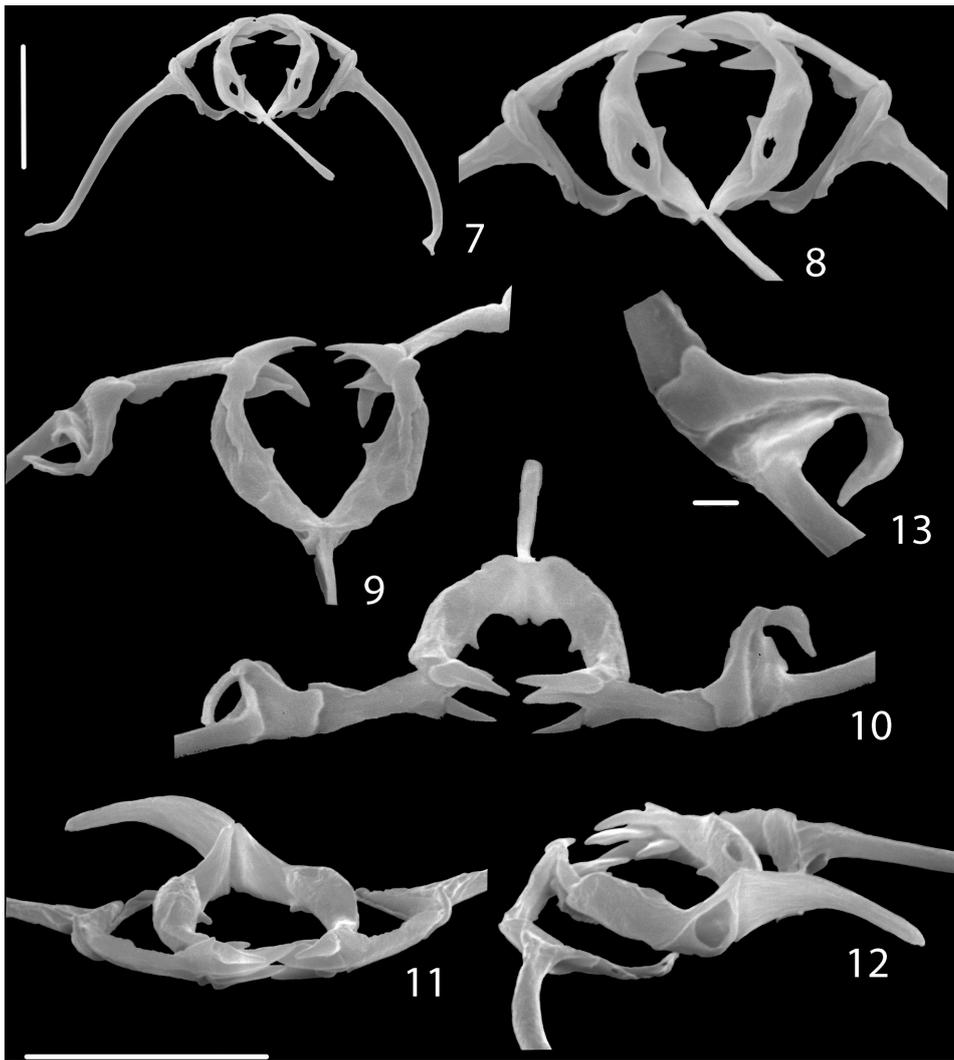
Measurements. Length (N = 5) 162–183  $\mu\text{m}$  (mean = 171  $\mu\text{m}$ ), toe 9–13  $\mu\text{m}$  (mean = 11  $\mu\text{m}$ ); trophi (N = 3) 23–24  $\mu\text{m}$ , ramus 8.5–10  $\mu\text{m}$ , fulcrum 6.5–8  $\mu\text{m}$ , uncus 8–9  $\mu\text{m}$ , intramalleus 4–6  $\times$  2  $\mu\text{m}$ , supramanubrium 5–5.5  $\mu\text{m}$ , manubrium 16–18  $\mu\text{m}$ .



**Figs 1–6.** *Encentrum essexis* sp. n.: 1 = female, ventral view, 2 = female, lateral view, 3 = toes, dorsal view, 4–5 = toes, lateral view, 6 = trophi, dorsal view. Scale bars: 1, 2: 50  $\mu\text{m}$ ; 3–6: 10  $\mu\text{m}$ .

Comments. On the basis of the morphology of the trophi, e.g. the presence of supramanubria, the posterior tapering and ventrally decurved fulcrum, and the shape of the rami outline, the new species belongs to the subgenus *Isoencentrum* De Smet, 1997.

The trophi of *E. essexis* sp. n. remind its congeners *E. frenoti* De Smet, 2002, *E. graingeri* Chengalath, 1985, *E. spinosum* Koch-Althaus, 1962 and *E.*



**Figs 7–13.** *Encentrum essexis* sp. n., SEM photographs of trophi: 7 = dorsal view, 8 = detail dorsal view, 9 = detail ventral view, 10 = detail ventro-apical view, 11 = detail dorso-apical view, 12 = detail dorso-lateral view, 13 = detail intramalleus and supramanubrium. Scale bar 10  $\mu$ m.

*tobyhannaensis* Myers, 1940, which show a tooth on the sub-basal rami chambers likewise. Of these, *E. frenoti* and *E. graingeri* are marine elements, and the others inhabit freshwaters. *Encentrum essexis* sp. n. shares the character two pairs of pre-uncinal teeth with *E. graingeri*, but differs by the hexagonal rami outline (circular in *E. graingeri*), and the uncinal teeth which are slightly shorter than the shaft (shaft-length in *E. graingeri*). The other species display a single pair of preuncinal teeth (however, not confirmed by SEM for *E. spinosum* and *E. tobyhannaensis*), and show an obpyriform (*E. frenoti*, *E. spinosum*) or heart-shaped (*E. tobyhannaensis*) rami outline. A pronounced long spiniform process on the medial intramalleus margin is only present in the new species. Further major differences are found in anatomical and external morphological features. The three light-refracting bodies in each toe are present in the new species only. The most obvious differences to *E. frenoti* are the lack of S-shaped glandular appendages connected to the brain, the normal bladder (long in *E. frenoti*), and the continuous outline of the toes (toes abruptly offset near mid-length in *E. frenoti*). *Encentrum essexis* sp. n. differs from *E. graingeri* by its more robust toes, the ventral corona (oblique in *E. graingeri*), and the medium-long stalks of the gastric glands (long-stalked in *E. graingeri*).

The new species differs from *E. spinosum* by the absence of longitudinal folds in the anterior half of the trunk. *Encentrum essexis* sp. n. is distinct from *E. tobyhannaensis* by its conical toes (parallel-sided in the latter), and the absence of a long retrocerebral sac and zoochlorellae in the stomach wall, and the presence of gastric glands.

Distribution and ecology. To date, *E. essexis* sp. n. is only known from its type locality: the Blackwater River near Kelvedon (51°50'0"N, 0°43'0"E) in Essex, UK. The specimens of *E. essexis* were found in only one of 25 benthic samples. In the same area, there was a diverse protozoan and invertebrate assemblages including 34 testate species, 20 species of chironomids, 7 oligochaete and 21 rotifer species. The most abundant taxa in February 2000 were testate amoebae (76%), followed by ciliates (12%) and rotifers (7%) (SCHMID & SCHMID-ARAYA unpubl.). Among rotifers, the most abundant species were *Philodina flaviceps* Bryce, 1906 (10%), *Encentrum* spp. (59%), and *Colurella adriatica* Ehrenberg, 1831 (6%) co-occurring with the new *Encentrum* species.

Further upstream in the same catchment, REISS and SCHMID-ARAYA (2008) found very diverse ciliate and meiofaunal assemblages composed of 32 species of ciliates, 52 species of rotifers and a further 35 species belonging to i.e. oligochaetes, copepods, gastrotrichs and nematodes. The rotifers were very abundant in the Pant stream and accounted for more than 80% of the total meiofaunal abundance in spring, but they did not contribute substantially to biomass and secondary production (REISS & SCHMID-ARAYA 2008). The most abundant among the rotifers were *Proales fallaciosa* Wulfert, 1937 (27%), *Notholca squamula* (Müller, 1786) (23.6%), *Resticula* sp. (6.7%), and *Cephalodella*

spp. (6.7%) (REISS pers. comm.). The genus with most species was *Cephalodella* (*C. cf. euderbyi* Wulfert, 1940, *C. gibba* (Ehrenberg, 1830), *C. globata* (Gosse, 1887), *C. cf. intuta* Myers, 1927, *C. megaloccephala* (Glascott, 1893), *C. pachyodon* Wulfert, 1937, *C. ventripes* (Dixon-Nutall, 1901) and several types of *Cephalodella* spp.), followed by *Encentrum* (*E. cf. uncinatum* (Milne, 1886), *E. putorius* Wulfert, 1936, *E. cf. eurycephalum* Wulfert, 1936, *E. incisum* Wulfert, 1936, and *Encentrum* spp.), *Dicranophorus* (*D. forcipatus* (Müller, 1786), and *Dicranophorus* spp.) and the bdelloid *Philodina* (*P. acuticornis* Murray, 1902, *P. citrina* Ehrenberg, 1832, *P. flaviceps* and *Philodina* spp.). This largely agrees with former observations that three families, Dicranophoridae, Notommatidae and Philodinidae, account for most of the about 150 rotifer species reported from benthos of lotic environments (SCHMID-ARAYA 1998b, WALLACE *et al.* 2006).

The genus *Encentrum* is omnivorous, comprising species feeding on detritus and associated bacteria, unicellular algae, diatoms, testate amoebae, euglenoids, ciliates, nematodes, rotifers, etc. (DE SMET 1997). Some species feed equally on different food items, e.g. diatoms and other rotifer species (SCHMID-ARAYA & SCHMID 1995). Examination of the gut contents of *E. essexis* sp. n. reveals that it selectively feeds on diatoms, such as *Navicula lanceolata* (Agardh) Ehrenberg, 1838.

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