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New and known species of *Dactylogyrus* Diesing, 1850 (Monogenea, Dactylogyridae) from cyprinid fishes of the River Tigris, Iraq

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Abstract

Four new *Dactylogyrus* species are described and two redescribed from cyprinids of the River Tigris, Iraq. These are as follows: *Dactylogyrus barbioides* n. sp. from *Barbus grypus*; *D. orbus* n. sp. from *Barbus lacerta*; *D. barbuli* n. sp. from *Barbus barbulus*; *D. macrostomi* n. sp. from *Cyprinion macrostomi*; *D. pavlovskyi* Bychowsky, 1949 from *Barbus grypus* and *Barbus sharpeyi*; and *D. inutilis* Bychowsky, 1949 from *Barbus xanthopterus*. A phylogenetic and zoogeographical analysis is presented.

Introduction

The valleys of the Rivers Tigris and Euphrates are part of an intermediate zoogeographical region situated between the Palaearctic and Sino-Indian regions (Berg, 1940, 1949). Its ichthyofauna consists of not less than 54 species and subspecies, being composed mainly of endemic cyprinids and clarids. This fauna is most closely related to the Palaearctic fauna, as is shown by the presence of genera such as *Salmo*, *Leuciscus*, *Aspius*, *Chondrostoma* and *Chalcalburnus*. Indian faunal constituents are members of *Glyptothorax* and [illegible] and Indo-African forms include a variety of *Barbus* species.

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Monogeneans from the fish of this region have been described only from *Barbus* and *Mugil* species in the River Karkheh (Iran) by Bychowsky (1949). Two of them were identified as *Dactylogyrus* Diesing, 1850, one as *Ancyrocephalus* Creplin, 1839; the latter is now placed in the genus *Ligophorus* Euzet & Suriano, 1977.

Iraqi authors (Ali *et al.*, 1986, 1987a,b) initially studied the parasites of the cyprinids. They mentioned *Dactylogyrus cornu* Linstow, 1878, *D. vastator* Nybelin, 1924, *Diplozoon kasimii* Rahemo, 1980 and *Gyrodactylus elegans* Nordmann, 1832, but they did not describe these species in [illegible] *ius mokhayeri*, from *Aspius vorax* has been described from the Iranian part of the region by Jalali & Molnar (1990).

In the present paper, we are reporting on the

occurrence and give description of both new and known *Dactylogyrus* species from the gills of cyprinids in the Tigris River and its tributaries.

Materials and methods

The monogeneans were collected from the River Tigris near Baiji, Iraq. Scrapings were taken from the infected gills and mounted on slides in glycerine jelly under a coverslip. Care was taken to flatten the specimens only gently. Measurements and drawings were made using a light microscope with a drawing attachment. The terminology and measurements are in accordance with Llewellyn (1963), but modified after Gussev (1983). All measures are given in micrometres.

Results

Four new and two previously described species of *Dactylogyrus* were collected and are described below. All six monogeneans were found on the gills of their hosts.

***Dactylogyrus pavlovskyi* Bychowsky, 1949** (Fig. 1).

Hosts: *Barbus grypus* Heckel, *B. sharpeyi* Gunther.
Locality: River Tigris, near Baiji, Iraq.
Specimens studied: 19.

Description

Small worms; length of body up to 630; width 130. Four eye-spots. Marginal hooks with pivot well demarcated from handle; blade with indistinct heel. Length of marginal books 27–34; pairs 1 and 2 being shortest. Anchors of wunderi-type (Gussev, 1985); length 50–65 (based partly on data of Bychowsky); shaft 40–56; inner root 16–22; outer root 6–17; point 14–17. Dorsal bar of wunderi-type, 6–8 × 33–42. Ventral bar of typical barboid-type (Gussev, 1976). 5-rayed, 45–55 × 30–40. Copulatory organ very long, with very long thread-like tube and bulb-shaped base; accessory piece extending from base, with thread-like mid-region and enlarged extremity; first part of tube and accessory piece twisted. Direct end to end measurement of copulatory organ 170–260, but full length of tube following curves up to 500; enlarged extremity of accessory piece 55–60. Vaginal tube thin, enlarged at ends, forms 4–6 spirals; diameter of the spirals 25–32; full length of tube up to 440; diameter of tube at its extremity 1 and in middle 4.

Comment
According to Bychowsky (1949) *D. pavlovskyi* specimens from *B. grypus* have larger chitinoid structures than specimens from *B. sharpeyi*. Such differences were not observed in the present material.

***Dactylogyrus inutilis* Bychowsky, 1949** (Fig. 2)

Host: *Barbus xanthopterus* (Heckel).
Locality: River Tigris, near Baiji, Iraq.
Specimens studied: 2.

Description

Small worms, with 2 pairs of eye-spots. Body length up to 800, width 130. Marginal hooks with slightly projected heel of blade, length 26–32. Needle-shaped structures present laterally to marginal hooks no. 2. Anchors of wunderi-type, length 55–63; shaft 43–49; inner root 17–21; point 15–19. Dorsal bar of wunderi-type (Gussev, 1985), 5–8 × 40–44. Ventral bar 5-rayed, of typical barboid-type, 45–50 × 32–38. Copulatory organ similar to that of *D. carpathicus* Zachvatkin, 1951 and *D. kulwieci* Bychowsky, 1931 and resembling that present in other *Dactylogyrus* species on *Barbus*. Copulatory tube S-shaped, with bean-shaped base thickened posteriorly and tapering anteriorly. End of copulatory tube hidden by widened portion of accessory piece. Total length of copulatory organ 50–52; base 18–19 × 7; diameter of tube in middle c.2. Sclerotised vagina

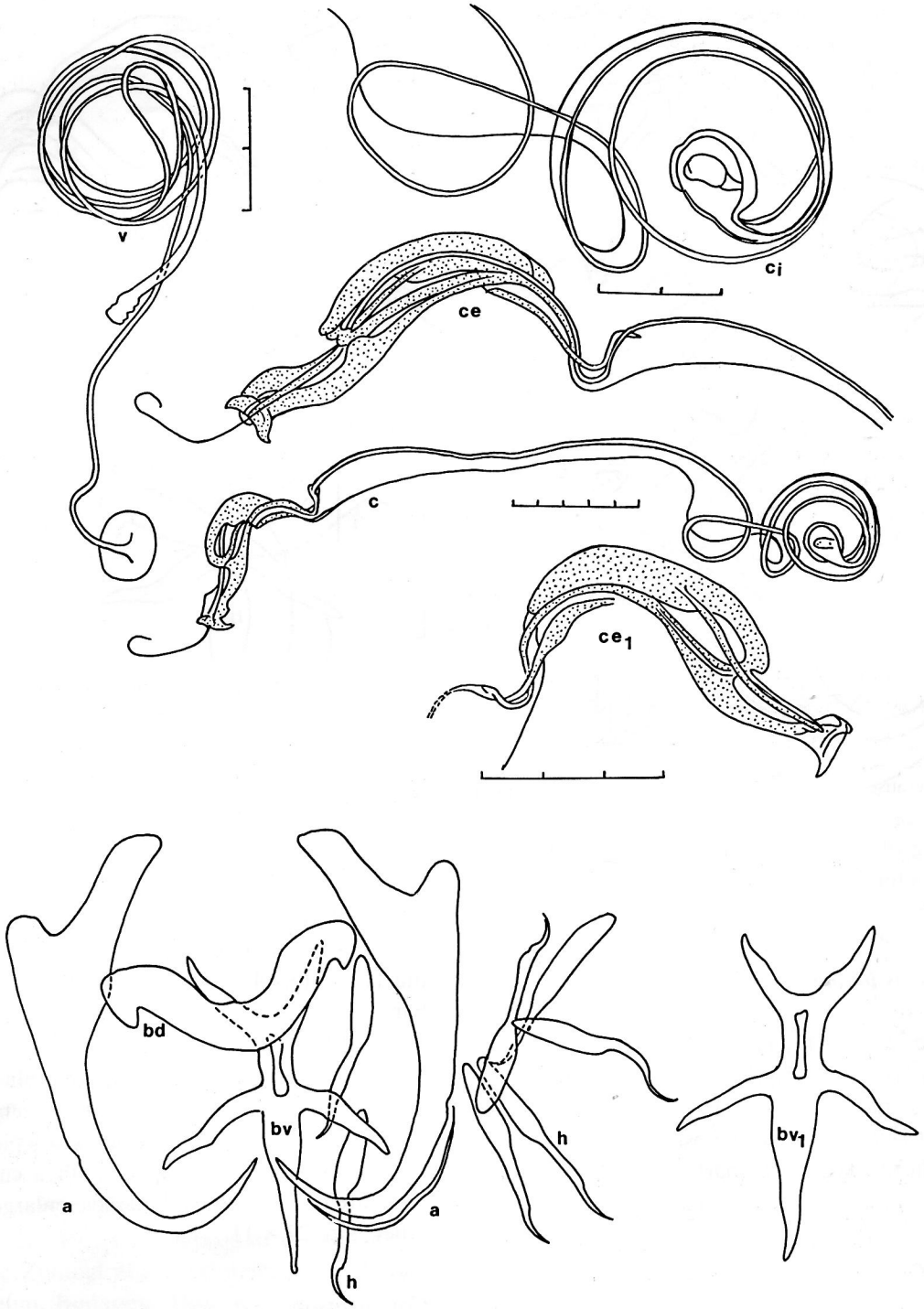

Fig. 1. Sclerotised structures of *D. pavlovskyi* from *Barbus sharpeyi*. *Abbreviations*: a, anchors; h, marginal hooks; bd, dorsal bar; bv, ventral bar; c, copulatory organ; ci, base of the copulatory organ; ce, enlarged part of accessory piece; v, vagina. bv_1 and ce_1 from *B. grypus*. One unit of scale-bar = 10 μm.

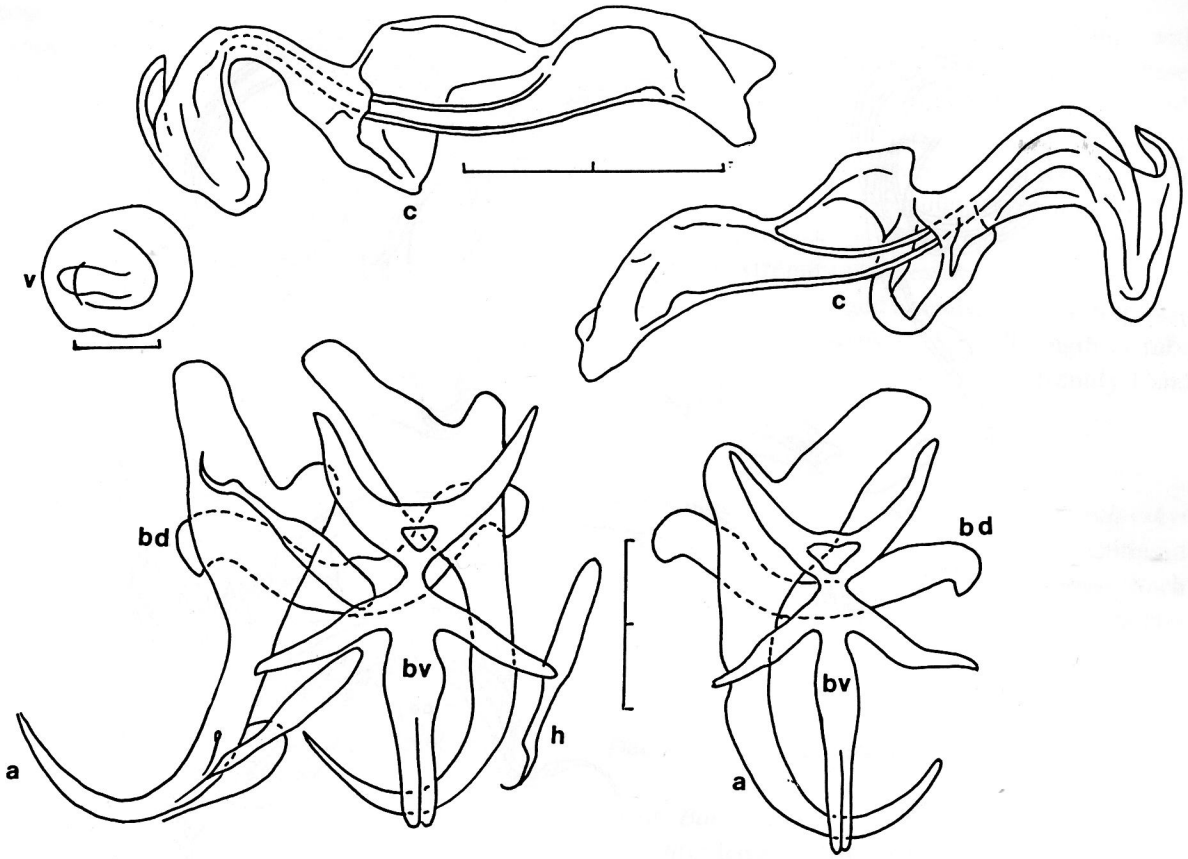

Fig. 2. Sclerotised structures of *D. inutilis*. for abbreviations and scale see Fig. 1.

consisting of round plate with short tube; length c.7. diameter 2.5.

***Dactylogyrus barbioides* n. sp.** (Fig. 3)

Type-host: *Barbus grypus* Heckel.
Type-locality: River Tigris, near Baiji, Iraq.
Specimens studied: 8.
Type-material: Holotype deposited in the collection of the Zoological Department, Natural History Museum, Budapest, Hungary.

Description

Small worms with 2 pairs of eye-spots. Body length up to 565, width 160. Marginal hooks with distinctly projected heel of blade; length 30 (pair no. 1), 40 (pair no. 2). Anchors of wunderi-type with well-developed roots and curved tip. Total length of anchors 54–56; shaft 49–51; inner root 21–23; outer root 8; point 17–18. Dorsal bar slightly different from wunderi-type, its lateral extremities being enlarged; with lateral indentations but no postero-lateral projections. Size of dorsal bar 3.5–8 × 35–41. Ventral bar simple, straight and slightly enlarged in middle, 1.5–2.5 × 25–28. Copulatory organ composed of thin, slightly curved tube with bubble-shaped or triangular enlarged portion and bifurcate accessory piece. Vagina sclerotised, bean-shaped, with a cup-shaped structure on one side and massive enlargement on other; size 22 × 11.

Comments

D. barbioides n. sp. closely resembles the Indian species *D. barbi* Gussev, 1976, *D. tori* Gussev, 1976 and *D. dubii* Gussev, 1976, and also the African species *D. ruahae* Paperna, 1973 and *D. clani* Guegan & Lambert, 1990, with regard to its

Fig. 3. Sclerotised structures of *D. barbioides* n. sp. a, h, bd, bv, c and v from the holotype; bv_1, c_1 and v_1 from the paratype. For abbreviations and scale see Fig. 1.

marginal hooks, anchors, ventral bar and copulatory organ, but differs from these species in the structure of the vagina and dorsal bar.

Dactylogyrus orbus n. sp. (Fig. 4)

Type-host: *Barbus lacerta* Heckel.
Type-locality: River Tigris, near Baiji, Iraq.
Specimen studied: 1.
Type-material: Holotype deposited in the collection of the Zoological Department, Natural History Museum, Budapest, Hungary.

Description

Small worms with 4 eye-spots. Body length 560, width 120. Marginal hooks with slightly projected heel of blade, length 25–35. Anchors of wunderi-type, length 52; shaft 15. Dorsal bar not of typical wunderi-type, being slightly more enlarged medially, with mid-region slightly curved posteriorly; size 8 × 39. Ventral bar T-shaped, 15 × 30. Copulatory organ with slightly curved tube swollen at base. Accessory piece consisting of 2 adjoining shields with hook-like protrusion arising from its centre. Total length of copulatory organ 50, diameter in middle c.2.5. and at its base 9–10. Vagina sclerotised, with semicircular shield, 10 in diameter.

Comments

D. orbus n. sp. differs from almost all *Dactylogyrus* species from the Palaearctic region, India, Mesopotamia and Africa because of its T-shaped ventral bar. Such a ventral bar is present

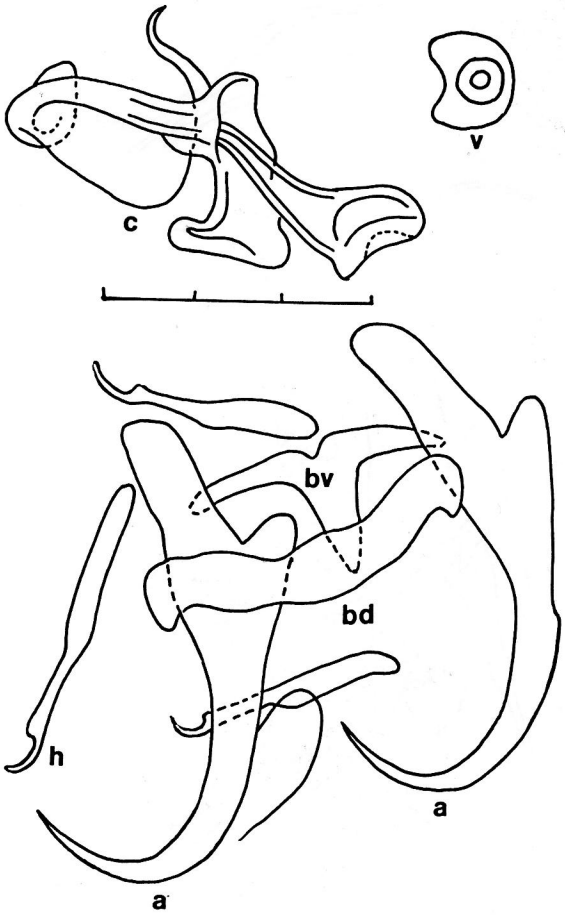

Fig. 4. Sclerotised structures of *D. orbus* n. sp. For abbreviations and scale see Fig. 1.

in *D. longicopula* Bychowsky, 1936 and *D. drjagini* Bychowsky, 1936 (Gussev, 1985). However, the shape of marginal hooks, plus the structure of the copulatory organ and vagina are different to these two species. In addition, they have different hosts.

***Dactylogyrus barbuli* n. sp.** (Fig. 5)

Type-host: *Barbus barbulus* Heckel.
Type-locality: River Tigris, near Baiji, Iraq.
Specimens studied: 3.
Type-material: Holotype deposited in the collection of the Zoological Department, Natural History Museum, Budapest, Hungary.

Description

Worms of medium size with 4 eye-spots; body length up to 1,100, width 190. Marginal hooks with round, well-projected heel of blade, 37–43. Anchors stout, rather short; total length 60–62; shaft 41–45; inner root 9–10; point 19–21. Dorsal bar of wunderi-type; middle strongly curved backwards; 6–7 × 49–51. Ventral bar 5-rayed, of barboid-type but with short posterior process and straight lateral processes running perpendicular to its axis; 40–42 × 26–27. Copulatory organ with spiral tube of 2 or 3 coils; base of tube enlarged, triangular. Accessory piece connected to base of tube by ligament and coiled 1.5 times. End of accessory piece enlarged, with elongate cavity terminating in structure resembling chicken's head with open beak. Total length of copulatory organ 70–82; full length of tube 270–330; base of tube 32–33 × 12–17; diameter in middle less than 1. Vagina sclerotised forming coiled tube; diameter of coil 33–35; diameter of tube medially 1.5, terminally c. 3.

Comments
The copulatory organ of *D. barbuli* resembles that of *D. varicorhini* Bychowsky, 1957. The shape of its ventral bar is, however, similar to that of species of the barboid-group, which are common in Central Asia and India. Compared with monogeneans of other faunal regions, no other morphological similarities were found.

***Dactylogyrus macrostomi* n. sp.** (Fig. 6)

Type-host: *Cyprinion macrostomi* (Heckel).
Type-locality: River Tigris, near Baiji, Iraq.
Specimens studied: 7.
Type-material: Holotype deposited in the collection of the Zoological Department, Natural History Museum, Budapest, Hungary.

Description

Small worms with 4 eye-spots. Body length up to 688, width 71. Marginal hooks with massive

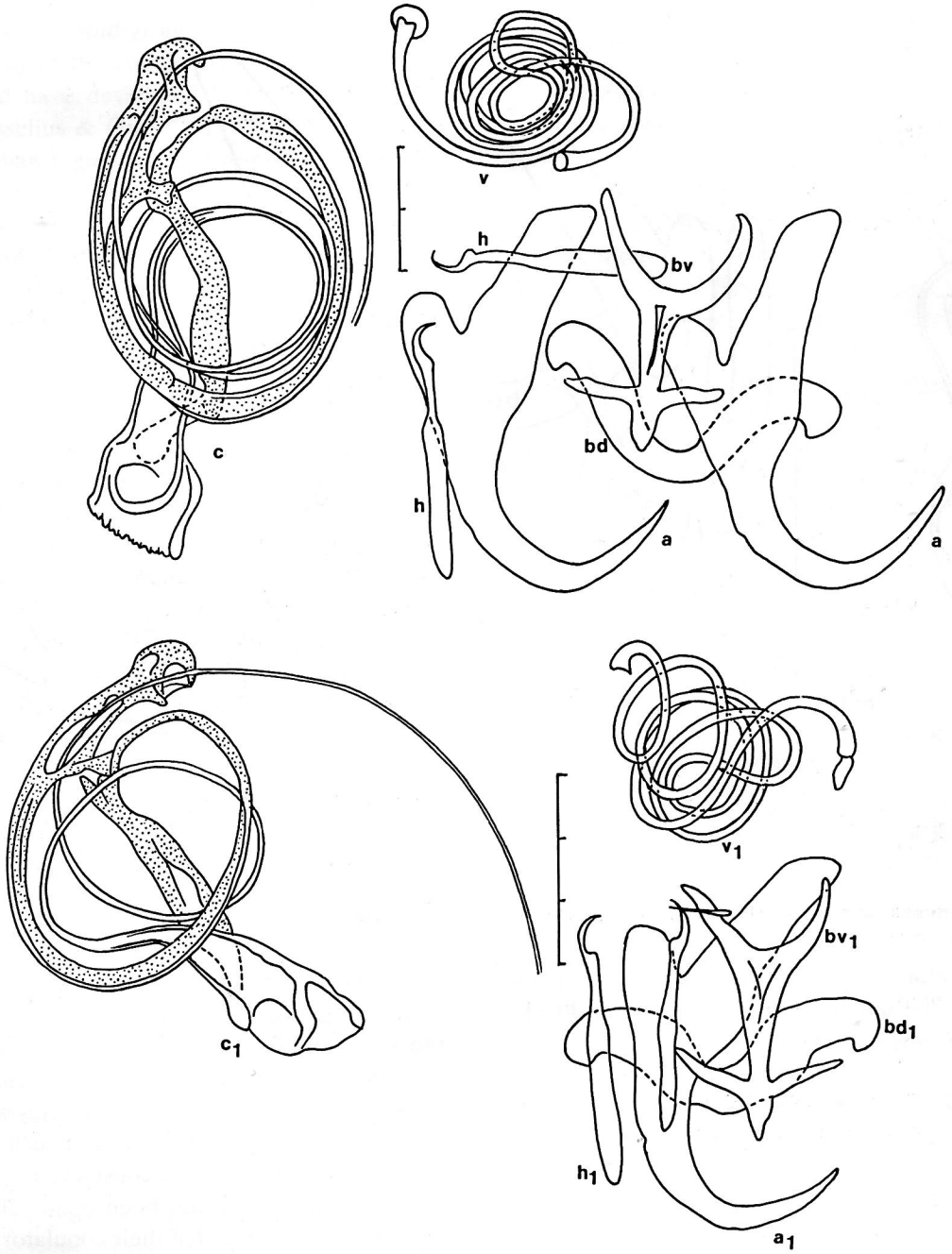

Fig. 5. Sclerotised structures of *D. barbuli* n. sp. a_1, bd_1, bv_1, h_1, c_1 and v_1 from the paratype. For abbreviations and scale see Fig. 1.

handle and distinct, rounded heel of blade; length 25–33. Anchors of wunderi-type; length 42–46; shaft 35–37; inner root 14–17; outer root 3–4; point 11–14 Dorsal bar of wunderi-type, 3–4 × 28–30. Ventral bar with very short anterior extension and lateral wings at an angle of 120°; 3–4 × 11–12. Copulatory organ tubular, S-shaped, with enlarged, almost cylindrical base and spear-shaped free end. Accessory piece arising from base of tube, wide proximally, claw-shaped dis-

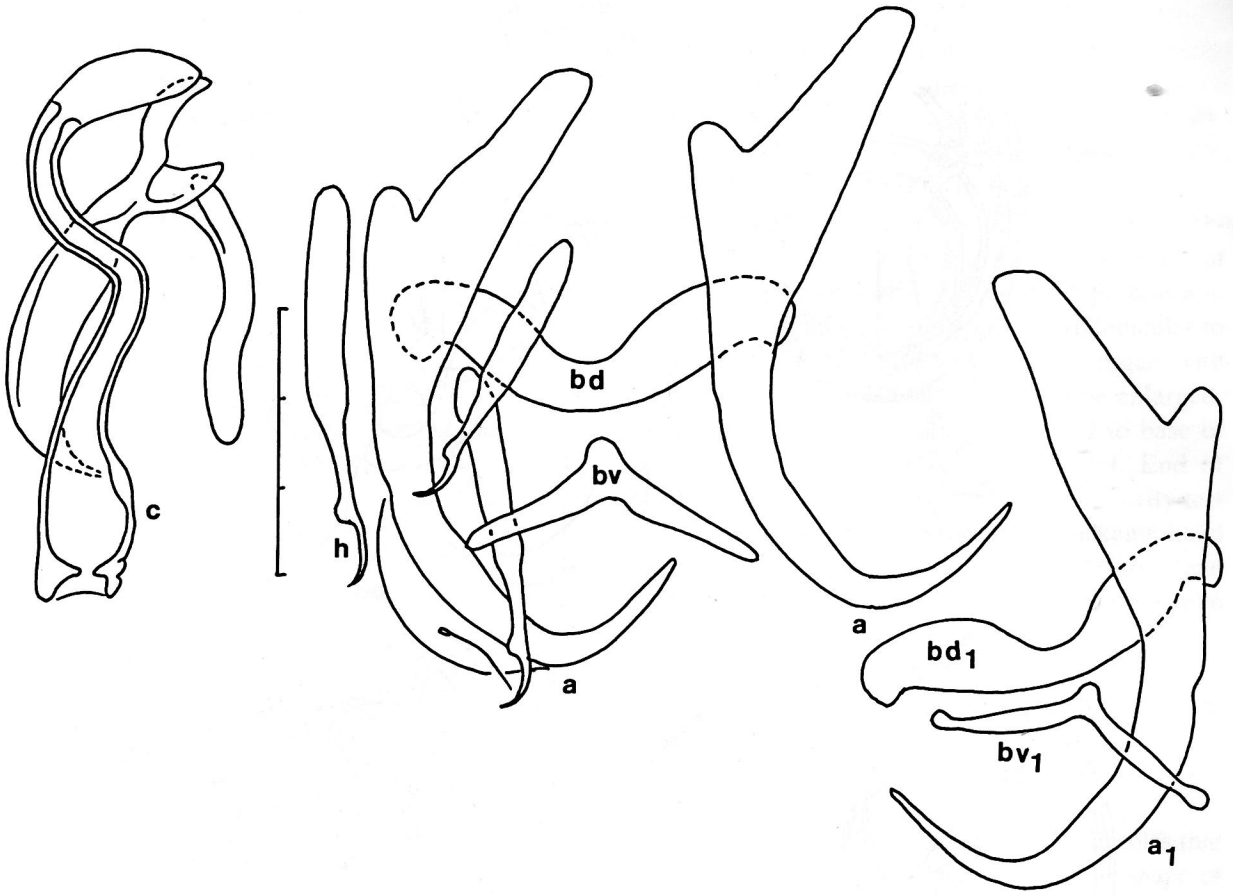

Fig. 6. Sclerotised structures of *D. macrostomi* n. sp. a_1, bd_1 and bv_1 from the paratype. For abbreviations and scale see Fig. 1.

tally with elongate, curved process extending posteriorly. Total length of copulatory organ 40; diameter of tube c.2; base 10 × 7.

Comment
This species resembles no other species.

Discussion

Of the six Iraqi species described here, *D. pavlovskyi* is of a special interest. Judging from the structure of its haptor, this species is a typical representative of the so-called barboid-group of *Dactylogyrus* spp., the members of which can be found on fish species of the genus *Barbus* and, less often, on species of *Varicorhinus*, *Labeo* and *Cirrhina* in the Palaearctic, the Ponto-Caspio-Aralic Region and in India (Gussev, 1976). The hosts of dactylogyrids of the barboid-group belong to the subfamily Barbinae, which are also common in Africa. The haptor has a five-rayed (sometimes a four-rayed) ventral bar. Only species within the Palaearctic Region and India have such a ventral bar. They might have been considered a phylogenetic group had there not been major differences between the structures of their copulatory organs. On the basis of these structures the members of the barboid-group can be divided into four types: the Palaearctic type, consisting of *D. goktschaicus* Gussev, 1966 and *D. linstowi Bychowsky*, 1936; the *D. kulwieci*-type (Gussev, 1985); the *D. inutilis*-type; and the Indian type, consisting of *D. pavlovskyi* and *D. vicinus* Gussev, 1976. *D. cornu* Linstow, 1878 and *D. cornoides* Glaser & Gussev, 1971 could be grouped into a fifth type, as they have different hosts to the mem-

bers of the barboid-group. On the basis of the morphology of the copulatory organ, *D. pavlovskyi* could have developed from *D. vicinus*, *D. labei* Musselius & Gussev, 1976 or other species of the Indian region with a five-rayed ventral bar (Gussev, 1976). The copulatory organ of *D. pavlovskyi* is very similar to that of *D. auricularis* (Nordmann, 1932). The latter species, however, lacks a ventral bar. Furthermore, it parasitises fish of the genus *Abramis*, which belongs to a different subfamily which is distributed in a different zoogeographical region (Gussev, 1985). The presence of a similar copulatory organ in species from different regions may be the result of convergent development of similar structures in non-related monogenean species.

D. barbioides n. sp. is closely related to *D. barbi* Gussev, 1976, *D. tori* Gussev, 1971 and *D. dubii* Gussev, 1976 which infect Indian species of *Barbus* (*Puntius*) and also to *D. ruahae* Paperna, 1973 and *D. clani* Guegan & Lambert, 1990 which infect African species of *Barbus*.

D. orbus n. sp. is characterised by a T-shaped ventral bar. A similar structure has been described previously only in Palaearctic species from the region of the Aral Sea, namely in *D. longicopula* Bychowsky, 1936 parasitising *Schizothorax* spp. and *D. drjagini* Bychowsky, 1936 parasitising *Dyptichus* spp. These fish genera belong to a subfamily different to that of the host of *D. orbis*. A T-shaped ventral bar is common in the dactylogyrids of the Amuro-Chinese fauna, although in the majority of these species the T-shaped bar is of a different type. No dactylogyrids of other faunal regions have a T-shaped ventral bar.

Because of its five-rayed ventral bar, *D. barbuli* n. sp. is related to the large group of dactylogyrids parasitising fishes of the subfamily Barbinae. Representatives of this subfamily are only present in the Palaearctic Region, in India, in Malaysia and, apparently, in Mesopotamia. A five-rayed ventral bar is not found in African *Dactylogyrus* spp., although numerous species are known from barbids and members of the closely related genus *Labeo*. Furthermore, there are *Dactylogyrus* spp. in the Amur River, Palaearctic Region, in India and in Africa with copulatory organs similar to that of *D. barbuli*. These species, however, belong to other morphological groups with different characteristics.

D. macrostomi n. sp. is not related to any hitherto described species. Although its ventral bar is similar to the ventral bar present in the Palaearctic and Far Eastern species of the genus, its copulatory organ is different.

On the basis of their morphological characteristics on one hand and their host specificity on the other, the new species appear to belong both to the Indian and to the Ponto-Caspio-Aralic faunas. There are presumably numerous other undescribed *Dactylogyrus* spp. on endemic fish in the Mesopotamian faunal region.

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