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Studies on Cercariae from Kuwait Bay VII. Description and Surface Topography of a New Cercaria, *Cercaria kuwaitae VII* (Opisthorchioidea: Heterophyidae)

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ABSTRACT—A new cercaria, *Cercaria kuwaitae VII*, is described from the intertidal prosobranch gastropod *Clypeomorus bifasciata* in Kuwait Bay. It is a heterophyid cercaria of the magnacercous type with its oral sucker modified into a penetration organ, eyespots, seven pairs of penetration glands, spherical epithelial excretory bladder and large pigmented tail. Probably it belongs to the heterophyid genus *Condylocotyla* or *Galactosomum.* Scanning electron microscopy was used to study the surface topography of the redial and cercarial stages.

INTRODUCTION

Studies of larval trematodes parasitizing aquatic molluscs have contributed to our understanding of the relationship, systematics and ecology of the parasites and their hosts. Gastropods of the family Cerithiidae are common and abundant in the high intertidal zone of all sub-tropical and tropical areas. Species from the Caribbean (Cable, 1956, 1963), the Mediterranean (Prévot, 1973; Pearson and Prévot, 1985) and the Indo-Pacific region (Ito, 1956; Reimer and Anantaraman, 1968; Cannon, 1978) have been found to harbor larval stages representing all major groups of trematodes. Studies on cercariae infecting *Cerithium moniliferum* (syn. *Clypeomorus batillariaeformis*) in the Great Barrier Reef, Australia (Cannon, 1978; Rohde, 1981), and *Clypeomorus bifasciata* in Kuwait Bay (Abdul-Salam *et al.*, 1994) revealed 12 species in each snail. Three of the cercariae found in *C. bifasciata* were of the magnacercous type characterized by an exceptionally long and distinctively pigmented tail attached to a heterophyid body. The present study describes one of them as a new cercaria, *Cercaria kuwaitae VII*. The surface topography of the cercarial and redial stages was examined by scanning electron microscopy.

MATERIALS AND METHODS

The magnacercous cercariae were obtained from naturally infected *Clypeomorus bifasciata* collected from southern shores of Kuwait Bay, during June to October 1993. The cercariae were studied live, unstained or vitally stained with neutral red, or after having been fixed in hot AFA and stained in acetocarmine. Earlier larval stages were obtained by dissecting infected snails. Measurements in micrometers with averages in parentheses were taken from 10 vitally stained, refrigerator-immobilized specimens. Figures were drawn with the aid of a camera lucida.

For scanning electron microscopy (SEM), living cercariae and rediae were fixed for 1 hr in a solution containing 4% formaldehyde and 1% glutaraldehyde in 0.1 M phosphate buffer (pH 7.2) at 4°C. Following an appropriate wash in the same buffer, the specimens were post-fixed in 1% osmium tetroxide in 0.1 M phosphate buffer (pH 7.2) for 5 min at 4°C, dehydrated in an acetone series and critical-point dried. Dried specimens were mounted on stubs, coated with gold and examined under a Jeol 840 electron microscope.

The cercaria described in this paper is designated following the system of Cable (1956, 1963).

RESULTS

Cercaria kuwaitae VII (Figs. 1–10)

Description

Host: *Clypeomorus bifasciata* (Sowerby, 1855) (Prosobranchia: Cerithiidae).

Locality: Shuwaikh, Kuwait Bay, Kuwait.

Infection site: Gonad and hepatopancreas.

Prevalence of infection: 0.34% out of 2,358 snails.

Specimens deposited: Helminth collection, Department of Zoology, University of Kuwait (Accession No. KUHC-C7).

Cercaria (Figs. 1–7): Heterophyid cercaria of the magnacercous type. Body proper elongate, 250–320 (282) long, 80–110 (95.5) wide at mid level (Figs. 1 and 4). Tegumental spines arranged in regular rows, prominent anteriorly (Figs. 5–7). Oral sucker modified into a protrusible penetration organ, 28–41 (36.9) long by 21–35 (30.4) wide. Oral opening subterminal, transversely oval, lined by sclerotized perioral ring with 3 patches of enlarged preoral spines, dorsal patch in 2 rows of 6 spines in each, ventro-lateral patches in 3 rows of 3,5,4 spines in each (Figs. 2 and 6). Prepharynx 42–60 (51.2) long; pharynx 11–12 (11.5) in

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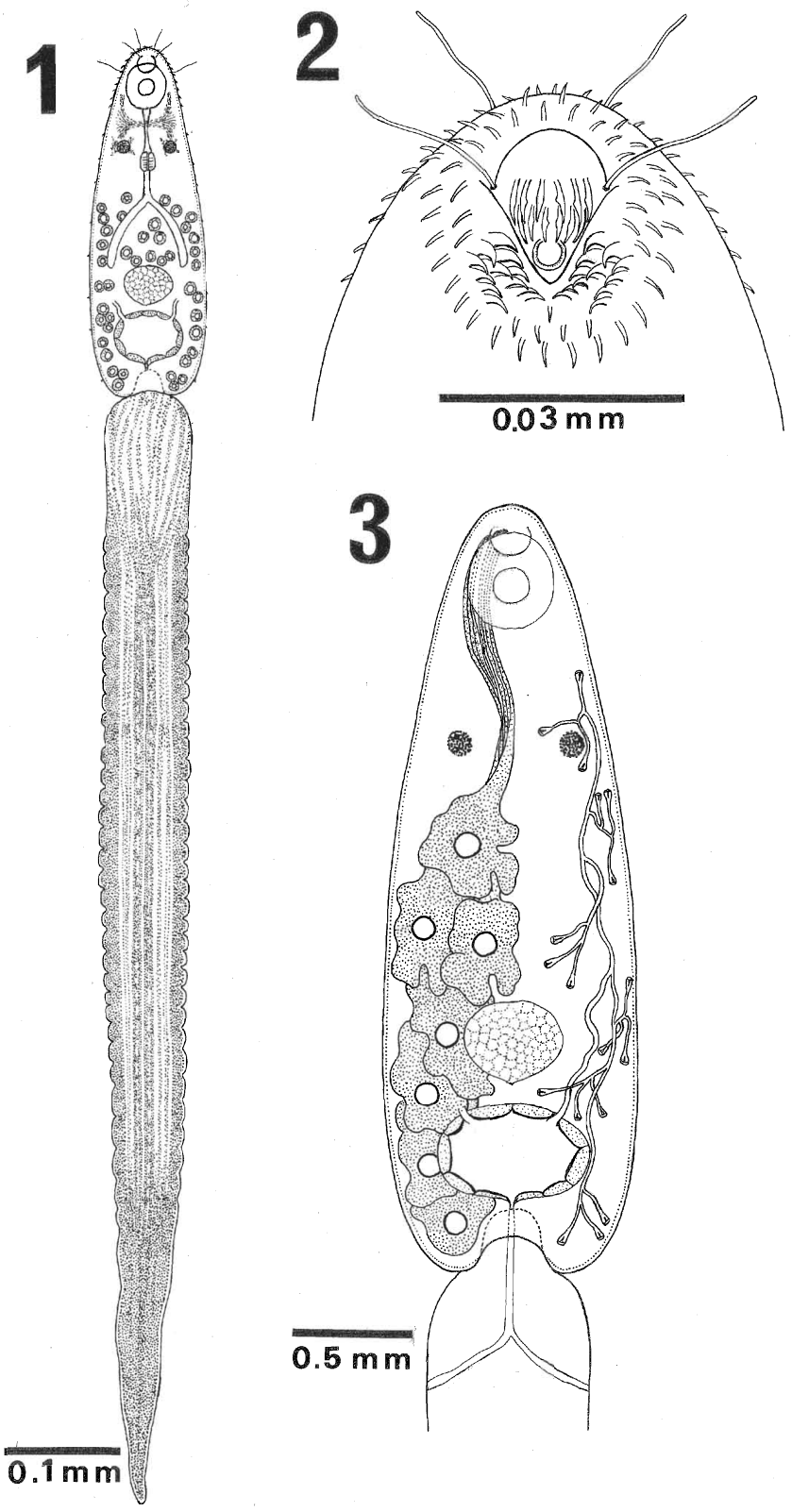
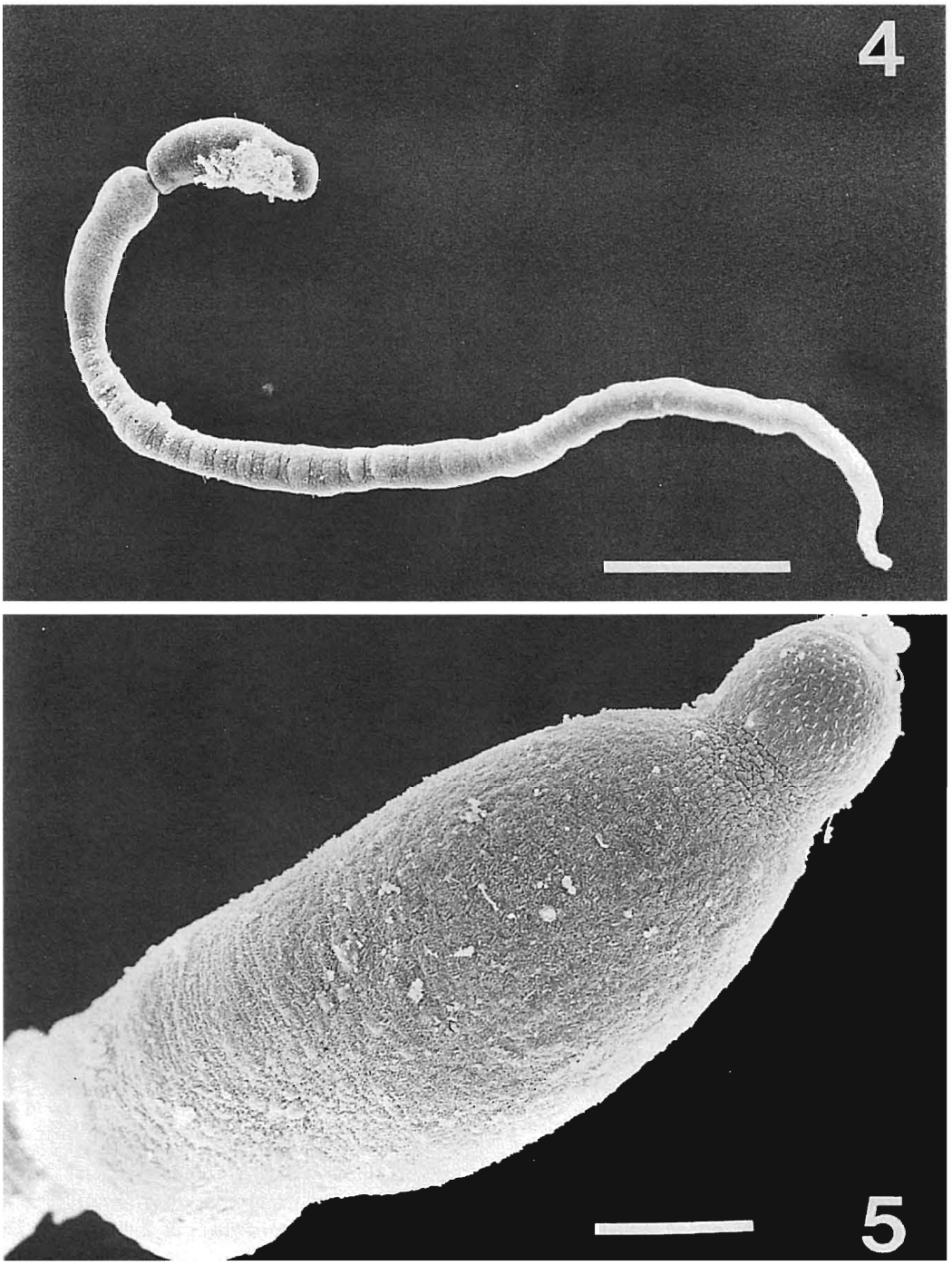
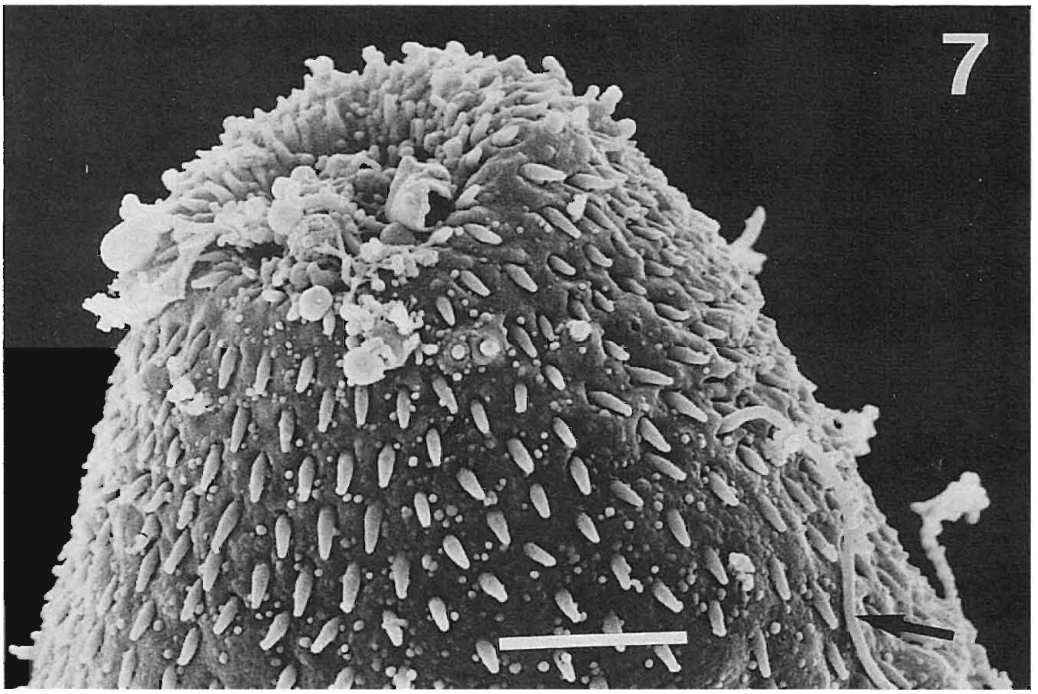


Figs. 1–3. *Cercaria kuwaitae VII*, cercaria. Fig. 1. Entire body, ventral view; Fig. 2. Preoral spines and cilia; Fig. 3. Excretory system and penetration glands.

diameter; esophagus 15–20 (17.9) long; caeca slender, extending to mid-body. Ventral sucker undeveloped. Eyespots round, 9–10 (9.8) in diameter, at pharyngeal level. Neural mass evident between eyespots and oral sucker. Seven pairs of penetration glands present posterior to eyespots, with 2 pairs of bundles of ducts opening in crypt dorsal to oral sucker in 3,4,4,3 arrangement. Three pairs of long cilia present in oral sucker region (Figs. 1, 6 and 7). Finely granular cystogenous cells more numerous in posterior half of body (Fig. 1). Excretory bladder spherical, thick-walled. Main excretory tubule arising from each anterolateral part of excretory bladder, extending anteriorly



Figs. 4–7. SEM micrographs of *Cercaria kuwaitae VII*, cercaria. Fig. 4. Body covered with secretory material oozing from oral sucker region, and tail with swollen proximal and tapered distal portions, ventro-lateral view. Scale =100 μm; Fig. 5. Tegumental spines decreasing in size and density posteriorly, dorsal view. Scale = 20 μm; Fig. 6. Protruded oral sucker exposing oral opening armed with dorsal and ventro-lateral patches of enlarged spines. Globular materials dorsal to mouth, tegumentary spines and ciliated structures surrounding anterior end. Scale = 5 μm; Fig. 7. Tegumentary spines surrounding retracted oral sucker. Note a long cilium (arrow). Scale = 5 μm.

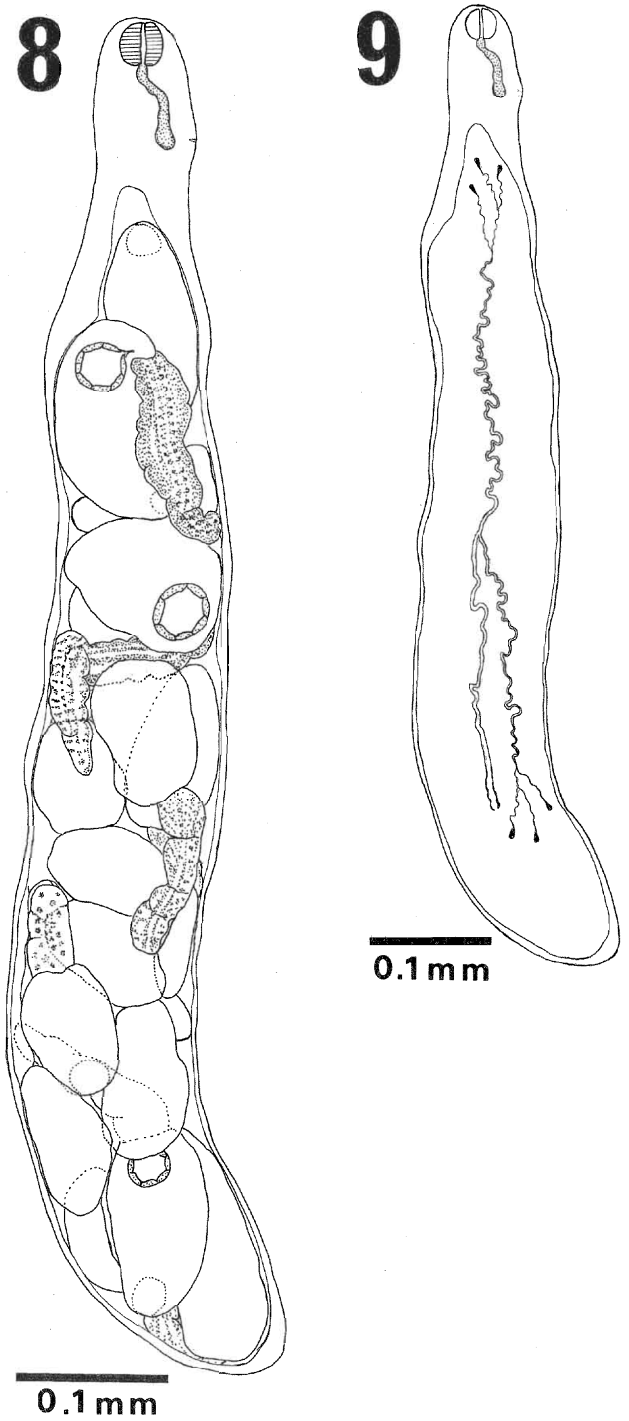


to mid-body, receiving anterior and posterior secondary tubules. Flame-cell formula 2[(3+3+3)+(3+3+3)]=36 (Fig. 3). Caudal excretory tubule running into tail, bifurcating near base, opening laterally. Genital primordium oval mass of cells just anterior to excretory bladder. Tail 820–1150 (955) long by 50–80 (66) wide, exceptionally long, slender, finely annulate, proximal portion swollen, distal portion slender and tapering at end, with longitudinal muscle fibers; deep purple pigmented granules prominent, more dense in distal portion (Fig. 1).

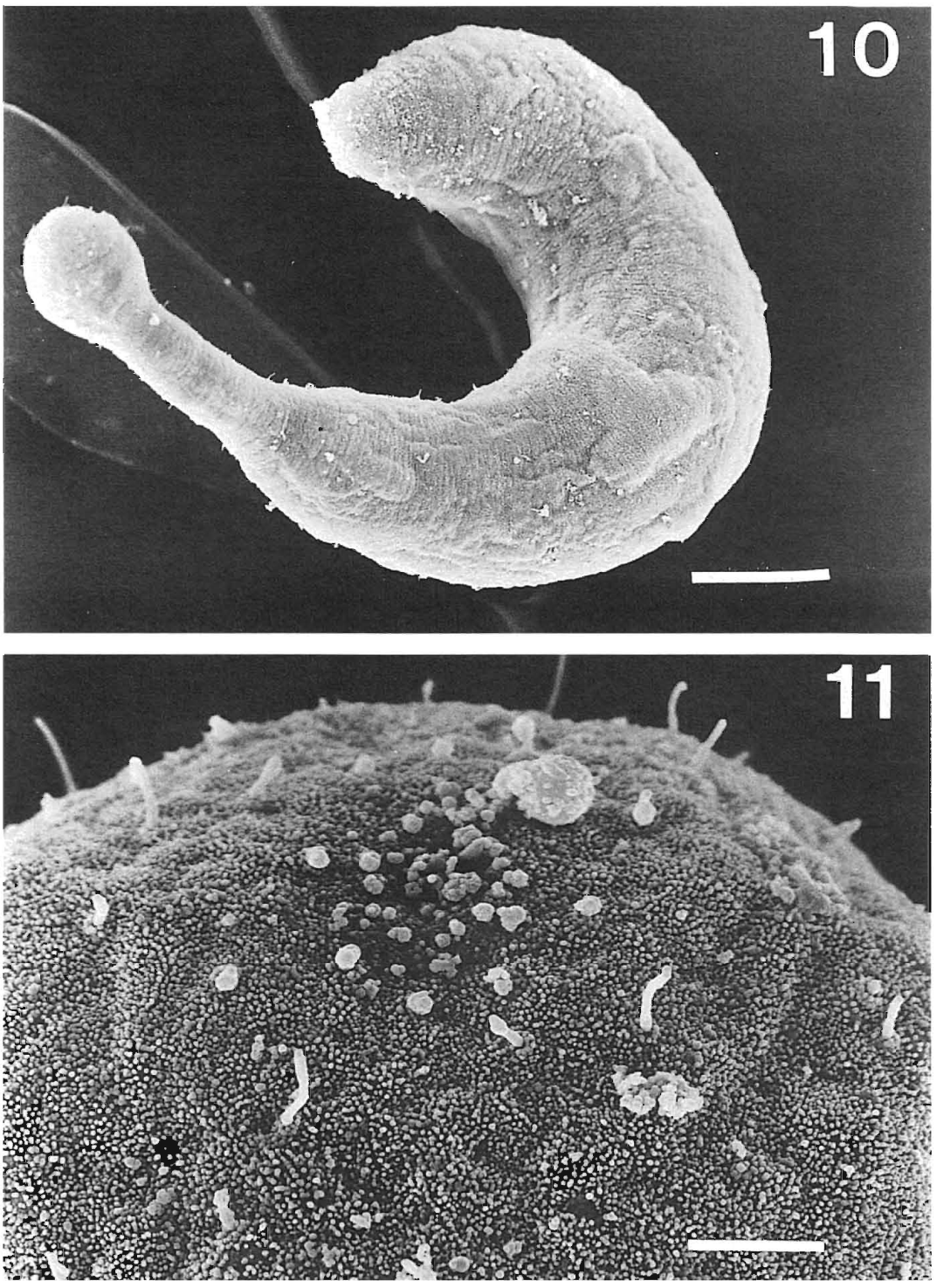
Behavior: Cercariae were strongly photopositive and swarm with figure-eight undulating movements of the tail with the body always at an angle to the tail. On the bottom of a container, they exhibited a serpentine movement.

Redia (Figs. 8–11): Body elongate, cylindrical, whitish, 820-970 (893) long by 140–190 (159) wide, with prolonged anterior end terminating in a spherical 'head' (Fig. 10). Tegument finely annulate, microvillous and ciliated. Oral

opening terminal, surrounded by cilia, bearing spherical bodies, probably secretory material (Fig. 11). Pharynx almost spherical, 27.5–32.5 (30.5) long by 27.5–30 (28) wide, followed by a small caecum. Birth pore near anterior end. Flame-cell formula 2[(3)+(3)]=12. Excretory pore located near posterior end of body (Fig. 9). Rediae contain only immature cercariae. Cercariae complete their development in the snail tissue after leaving rediae.



Figs. 8–9. *Cercaria kuwaitae VII*, redia. Fig. 8. Mature redia containing cercariae; Fig. 9. Excretory system.



Figs. 10–11. SEM micrographs of *Cercaria kuwaitae VII,* redia. Fig. 10. Body with spherical anterior end and tegument finely annulate and covered with ciliated sensory structures prominent anteriorly. Scale=150 μm; Fig. 11. Closed oral opening surrounded by ciliated structures and spherical bodies probably secretory material. Tegumental surface covered with microvilli-like projections. Sclae=5 μm.

DISCUSSION

Because of the presence of an oral sucker modified into a penetration organ, preoral spines, eyespots, seven pairs of penetration glands, a spherical excretory bladder and a large pigmented tail, *Cercaria kuwaitae VII* is clearly a heterophyid cercaria of the magnacercous type. Similar cercariae have been reported from marine snails, mainly cerithiids, in the Caribbean (Cable, 1956, 1963), the Mediterranean (Prévot, 1973; Pearson and Prévot, 1985) and the

Indo-Pacific region (Ito, 1956; Reimer and Anantaraman, 1968; Cannon, 1978). Although these cercariae are closely similar to one another in body features, they have some differences in the number and arrangement of preoral spines (Table 1). Evidently, *Cercaria kuwaitae VII* is a new magnacercous cercaria. In addition, the new cercaria differs from *Cercaria queenslandae IX*, the only other magnacercous cercaria described from a *Clypeomorus* (Cannon, 1978), in the absence of a rudimentary ventral sucker and the pigmentation pattern of the tail. In the shape and pigmentation of the tail, the new cercaria most closely resembles *C. caribbea XIX* (Cable, 1956). Cable described the magnacercous cercariae *Cercaria caribbea XVII-XIX* (Cable, 1956) and *LXXI* (Cable, 1963) and suggested that they may be larval stages of the genus *Galactosomum* Looss, 1899 (Heterophyidae). Subsequently, Prévot (1973), Pearson and Prévot (1985) and Rekharani and Madhavi (1985) experimentally elucidated the life-cycles of the heterophyids, *Galactosomum timondavidi*, *Condylocotyla pilodora* and *G. ussuriense*, respectively, in which the cercariae are of the magnacercous type. Pearson (1973) suggested that the worm-like appearance and movement and the brilliant color of the tail, characteristic of magnacercous cercariae, probably attract plankton-feeding fish serving as the second intermediate host.

Cercaria kuwaitae VII is a third heterophyid and a first

Table 1. Comparison of the number and arrangement of preoral spines of the heterophyid magnacercous cercariae and their snail hosts and geographical localities

Magnacercous species (Reference)	Preoral spines*		Snail host	Locality
	Dorsal Patch	Ventro-lateral Patches		
Cercaria caribbea XVI (Cable, 1956)	1) 12 2) 12	Absent	*Cerithium algicola*	Puerto Rico
Cercaria caribbea XVII (Cable, 1956)	1) 6 2) 5 3) 4	1) 7 2) 7	*Turritella exoleata*	Puerto Rico
Cercaria caribbea XVIII (Cable, 1956)	1) 4 2) 4 3) 3	1) 4 2) 5	*Cerithium algicola*	Puerto Rico
Cercaria caribbea XIX (Cable, 1956)	1) 7 2) 6	1) 7 2) 6 3) 5	*Cerithium variabile*	Puerto Rico
Cercaria caribbea LXXI (Cable, 1963)	1) 7 2) 6	1) ND 2) ND 3) ND	*Cerithium variabile*	Jamaica
Cercaria komiyai (Ito, 1956)	1) 31–35 2) 10–15	1) 15–19	*Tympanotonus microptera*	Tokyo Bay
Cercaria kuwaitae VII (Present study)	1) 6 2) 6	1) 3 2) 5 3) 4	*Clypeomorus bifasciata*	Kuwait Bay
Cercaria melanocrucifera (Reimer and Anantaraman, 1968)	1) 5 2) 6	1) ND 2) ND 3) ND	*Turritella attenuata*	Bengal Bay
Cercaria nigrocaudata (Ito, 1956)	1) 18 2) 16 3) 10 4) 10	Absent	*Cerithidea largillierti*	Tokyo Bay
Cercaria queenslandae IX (Cannon, 1978)	1) 10 2) 12	Absent	*Cerithium moniliferum*	Great Barrier Reef
Condylocotyla pilodora (Pearson and Prévot, 1985)	1) 9	1) 11–12 2) 11–12	*Cerithium vulgatum*	Marseilles Bay
Galactosomum timondavidi (Prévot, 1973)	1) 9 2) 9	1) 3 2) 3	*Cerithium mediterraneum*	Marseilles Bay
Galactosomum ussuriense (Rekharani and Madhavi, 1985)	1) 11 2) 11	1) 14 2) 14	*Cerithium coralium*	Madras Coast

* Numbers of rows starting from the oral opening and spines in each row. ND=Number not determined.

magnacercous cercaria to be described from the Arabian Gulf region (Abdul-Salam and Sreelatha, 1993a, b). The second intermediate and definitive hosts are unknown. The available knowledge on the life cycles of heterophyids (Cable, 1956, 1963; Prévot, 1973; Yamaguti, 1975; Pearson and Prévot, 1985; Rekharani and Madhavi, 1985) suggests that the cercariae, after emerging out of snail hosts, encyst as metacercariae in small fish, that the adults occur in the intestine of piscivorous birds and mammals, and that the new cercaria probably belongs to the genus *Condylocotyla* Pearson and Prévot, 1985 or *Galactosomum* parasitizing some sea birds abundant in the locality where the infected snails were collected.

The general surface topography of the present cercaria and redia, as revealed by SEM observations, does not differ essentially from that of other heterophyids (Køie, 1977; Irwin *et al.*, 1978). The ciliated structures that concentrated on the penetration organ region and ventral surface of the body may be thigmo-receptors involved in finding the second intermediate host and selecting a penetration point. Similar structures have been observed on the body of other cercariae that actively seek the second intermediate host. Penetration and migration of the cercaria in tissue of the host is probably facilitated by the modified preoral spines and enzymes released from the penetration glands. Like rediae of other trematodes studied by SEM, the new redia has the body amplified by extensive tegumental microvilli, which may be associated with absorption of nutrients from the surrounding molluscan tissue. Living within the molluscan host tissue is further facilitated by the presence of the ciliated structure of the body, which may act as chemo- or thigmo-receptors involved in feeding and orientation. The structural character of the spherical bodies abundant in the anterior region of the redia is unknown. Similar structures have been observed on the surface of other trematode rediae and have been linked with the expulsion of waste material (Køie, 1971) and the provision of substances for redial locomotion (Rees, 1980).

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