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Two New Species of *Mantoscyphidia* Jankowski, 1980 (Ciliophora: Peritrichia), Gill Symbionts of *Haliotis* Linnaeus, 1758 (Mollusca: Archaeogastropoda) from the South Coast of South Africa

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Summary. Surveys carried out from 1995 to 1999 at the De Hoop Nature Reserve along the south coast of South Africa revealed the presence of scyphidiid peritrichs of the genus *Mantoscyphidia* Jankowski, 1980, occurring in abundance on the gills of *Haliotis spadicea* Donovan, 1808 and *H. midae* Linnaeus, 1758. These species differ from all the known *Mantoscyphidia* species with respect to morphology of the body and nuclear apparatus and are therefore described as two new species, *Mantoscyphidia spadiceae* sp. n. and *Mantoscyphidia midae* sp. n.

Key words: ectosymbiont, *Mantoscyphidia spadiceae* sp. n., *Mantoscyphidia midae* sp. n., marine mollusc, sessiline ciliophoran, scyphidiid peritrich.

INTRODUCTION

Fifteen *Mantoscyphidia* species have so far been found associated with freshwater and marine gastropod hosts. Four are from freshwater: *M. physarum* (Lachmann, 1856) from *Physa*; *M. limacina* (Lachmann, 1856) from *Planorbis*; *M. inclinata* (Lom & Corliss, 1968) from *Cincinnatia* and *M. capitis* (Boitsova, 1976) from an unknown host. The 11 known marine species of *Mantoscyphidia* are the following: *Mantoscyphidia patellae* (Hutton, 1878) from *Patella argentea*; *M. lusitana* (Cuénot, 1891) *emend* Jankowski, 1985 from *Patella vulgata*; *M. fischeri* (Vayssiére, 1885) from *Truncatella truncatula*; *M. littorinae* (Issel, 1918) from an unknown host; *M. hydrobiae* (Kahl, 1933) from *Hydrobia*; *M. ubiquita* (Hirshfield, 1949) from *Acmaea pelta*; *M. acanthophora* (Fish & Goodwin, 1976) from *Gibbula umbilicalis*, *M. bengalensis* (Jamadar & Choudhury, 1988) from *Cerithidea cingulata*; *M. branchi* Van As, Basson & Van As, 1998 from *Patella barbara*; *M. marioni* Van As, Basson & Van As, 1998 from *Nacella delesserti* and *M. fanthami* Basson, Botha & Van As, 1999 from *Oxystele variegata*.

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Surveys of two species of *Haliotis* collected at localities on the south coast of South Africa revealed the presence of two different scyphidiid peritrichs of the genus *Mantoscyphidia*, occurring in abundance on gills of the hosts. The two scyphidiids differ from all known *Mantoscyphidia* species with respect to general body morphology, characteristics of the nuclear apparatus, and host preference and are described here as new species.

MATERIALS AND METHODS

South African haliotids, i.e. *Haliotis spadicea* (venus ears) and *H. midae* (perlemoen) were collected from infratidal pools on the rocky shore and from an abalone aquaculture facility. A total of 225 haliotids were collected from the De Hoop Nature Reserve and from an Abalone Farm at Danger Point near Gansbaai, and examined during March and April over a five-year period from 1995 to 1999.

Haliotids were taken to a field laboratory where body dimensions and mass of the specimens were measured. Gills were dissected, placed on a microscope slide, smeared and examined using a compound microscope. Live specimens of scyphidiid peritrichs were observed to determine body contractility, position of contractile vacuoles and nuclei. Photomicrographs were taken of live specimens in various stages of contraction, for the purpose of measuring body dimensions.

Additionally, wet smears were fixed in Bouin's fluid, and transferred to 70% ethanol. In some cases, they were returned to the laboratory in Bloemfontein for further processing and, in other cases, hematoxylin staining was done in the field laboratory. Mayer's and Harris' Hematoxylin were used to stain the nuclear apparatus and for measuring body dimensions. The details of the infundibulum were studied by staining Bouin's-fixed smears with Protargol, using a combined method as described in Lee, Hunter and Bovee (1985) and Lom and Dyková (1992).

For scanning electron microscopy (SEM), gills were fixed in concentrations of 4 % and 10 % buffered, neutral formalin. In some cases, gills were fixed in Parducz and in 2.5 % glutaraldehyde. In the laboratory in Bloemfontein, the specimens were cleaned by washing gills in tapwater, dehydrated in a series of ethanol concentrations, and critical-point dried. Gills bearing ciliophorans were mounted on stubs, sputter coated with gold, and studied at 5kV and 10kV, using a JOEL WINSEM JSM 6400 scanning electron microscope.

For measurements of live specimens, minimum and maximum values are given, followed in parentheses by the arithmetic mean, standard deviation and number of specimens measured. Measurements based on Bouin's fixed specimens stained with hematoxylin are presented in square brackets. Body length was measured from the scopula to the epistomial disc and body diameter at the widest part of the body. Both macronuclear and micronuclear lengths were measured from adoral to aboral. Description of pellicular striations are from specimens viewed by SEM. The type material is in the collection of the National Museum, Bloemfontein, South Africa.

RESULTS AND DISCUSSION

Mantoscyphidia spadiceae sp. n. (Figs. 2-9)

Type host and locality: *Haliotis spadicea* Donovan, 1080, on gills; De Hoop Nature Reserve, south coast of South Africa (34°28'S, 20°30'E)

Type specimens: holotype, slide 97/04/05-04c (NMBP 235) in the collection of the National Museum, Bloemfontein, South Africa, Paratypes, slides 97/04/07-17 (NMBP 236), 98/04/05-06b (NMBP 237), hematoxylin stained, in the collection of the authors.

Etymology: named after the South African venus ear or siffie, *Haliotis spadicea*, on which the scyphidiid peritrichs occur.

Description

Body cylindrical, widening toward peristome (Figs. 2, 3, 7), extremely contractile. Peristomial disc ranging in shape from flattened to arched, with broad lip (Figs. 4, 6, 7) depending on body contraction. Very prominent peristomial apex (Figs. 4, 7). Body length 70-140 (104.3 ± 21.1, 43) [82-134 (100 ± 12.7, 47)], body diameter 20-40 (31.2 ± 6.7, 43) [26-60 (42 ± 6.5, 47)]. Scopula small (Figs. 3, 7), length 5-15 (9.9 ± 1.7, 43) [1-24 (10.3 ± 6.1, 47)], diameter 20-40 (31.7 ± 7.1, 43) [19-45 (30.2 ± 5.1, 47)].

Pellicular striations in expanded individuals (Figs. 3, 6) approximately 0.3µm apart, adorning whole body, including peristome (Figs. 5, 6) and scopula. Striations evenly spaced and uniform. Bifurcated pattern of striations found in some individuals on body and scopula. Bottom half of peristomial lip with uniform striation pattern in expanded specimens, upper half showing irregular pattern (Figs. 5, 6). Edge of peristome indistinct in contracted individuals, with striations forming a zig-zag pattern (Fig. 6). Trochal band consisting of seven or eight closely associated striations, forming slight elevations (Figs. 2, 3). Pellicular area between trochal band and scopula forming 5-8 elevations depending on degree of contraction.

Adoral zone describing one and one-half turns, about 540° (Figs. 4, 6), before plunging into infundibulum (Fig. 9). Row of pores located between ciliary spiral and peristomial lip (Fig. 6). Buccal apparatus as follows: haplo- and polykinety starting almost at same point, first three kinetosomes of polykinety barren. Haplo- and polykinety divided by pellicular ridge or comb, approximately same width as a kinetosome (Fig. 6). Polykinety

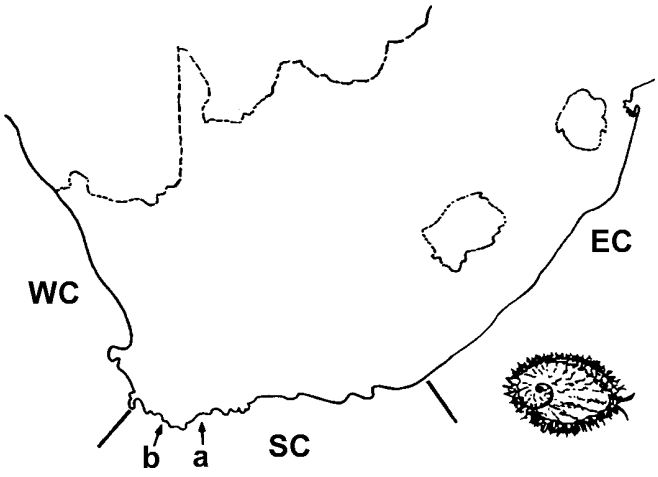


Fig. 1. Map of southern Africa showing the collection localities along the South African coastline. EC - East Coast, SC - South Coast, WC - West Coast, a - De Hoop Nature Reserve, b - Gansbaai

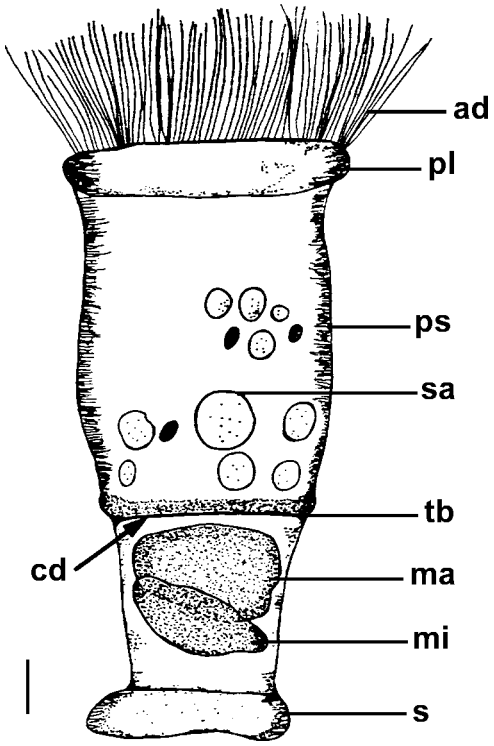


Fig. 2. Microscope projection drawing of *Mantoscyphidia spadiceae* sp. n. occurring on the gills of *Haliotis spadicea* Donovan, 1808, collected from the De Hoop Nature Reserve, South Africa. ad - adoral ciliary spiral, cd - cytoplasmic discontinuity, ma - macronucleus, mi - micronucleus, pl - peristomial lip, ps - pellicle striations, s - scopula, sa - symbiotic algae, tb - trochal band. Scale bar - 10 μm

three kinetosomes wide. Polykinety separates infundibular polykinetids after entering infundibulum (Fig. 9). Haplokinety makes one-half turn (180°), enters infundibulum beyond point at which polykinety enters. Fibrillar structure associated with polykinety. Inside infundibulum, polykinety makes one half turn (180°), haplokinety makes less than one half turn (<180°) before reaching cytostome (Fig. 9). Cytostome not always clearly visible.

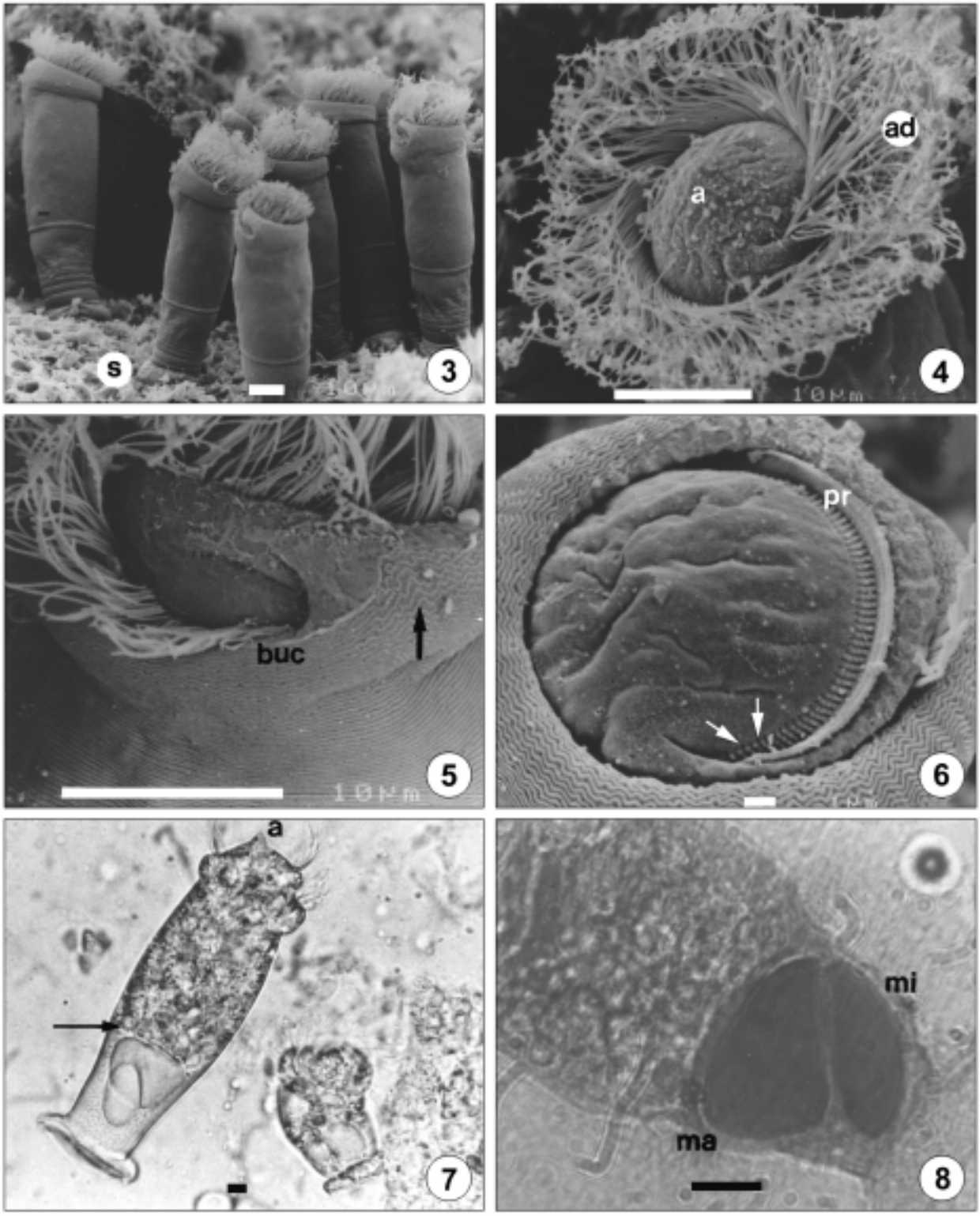
Cytoplasm homogenous to granular (Figs. 2, 7, 8). Contractile vacuole present, mostly in adoral third of body. Symbiotic algae occasionally found in cytoplasm, always adoral to trochal band, varying in number and size.

Nuclear apparatus occupies most of area below trochal band (Figs. 2, 7, 8). Discontinuity of cytoplasmic material (Figs. 2, 7) above nuclear apparatus, separating nuclear apparatus from rest of cytoplasm. Nuclear apparatus consists of single, large, spherical to ovoid macronucleus, length 10-25 (19.3 ± 3.4, 30) [11-27 (16.8 ± 3.9, 47)], diameter 20-40 (28.3 ± 5.8, 30) [17-38 (25.8 ± 4.4, 47)] and single, smaller, ovoid micronucleus, length 10-20 (10.8 ± 2.2, 37) [3-15 (10.2 ± 2.2, 47)], diameter 15-40 (22.2 ± 5.6, 37) [12-30 (21.1 ± 3.5, 47)]. Macronucleus adorally broad, tapering somewhat aborally, forming indentation occupied by micronucleus. The latter always situated aboral to macronucleus.

Remarks

Mantoscyphidia spadiceae is the third species of sessiline peritrich described from southern Africa and the first recorded from the genus *Haliotis* Linnaeus, 1758. It can be distinguished from the other species by differences in morphology of the nuclear apparatus, scopula and body shape.

Mantoscyphidia fischeri and *M. hydrobiae* have ribbon- and kidney-shaped macronuclei, respectively (Kahl 1933; and, see Table in Hirshfield 1949). It appears that *M. littorinae* has an oval to sausage-shaped macronucleus, situated in the aboral part of the body (Raabe 1952). *Mantoscyphidia acanthophora* has a C-shaped macronucleus (Fish and Goodwin 1976), which is situated, in the middle to adoral part of the body and a small scopula with cilia, the scopula of *M. spadiceae* also with short cilia, which are grouped together, with a form similar to that of *M. acanthophora*. In *M. branchi*, the scopula is broader with short densely grouped cilia (Van As *et al.* 1998). *Mantoscyphidia bengalensis* also has a small scopula but its macronucleus is conspicuous, cylindrical, and sometimes coiled (Jamadar and Choudhury 1988). In the forms with a coiled macronucleus, the macronucleus fills the entire



Figs. 3-8. Scanning electron micrographs (**3-6**) and photomicrographs (**7-8**) of specimens of *Mantoscyphidia spadiceae* sp. n. occurring on the gills of *Haliotis spadicea* Donovan, 1808, collected from the De Hoop Nature Reserve, South Africa. **3** - fully expanded specimens; **4** - body expanded, peristome arched; **5** - buccal cavity, uneven zig-zag striations indicated by arrow; **6** - adoral ciliary spiral with kinetosomes. Pores indicated by arrows; **7** - live specimen, discontinuity in cytoplasm indicated by arrow; **8** - hematoxylin stained specimen. a - apex, ad - adoral ciliary spiral; buc - buccal cavity; ma - macronucleus, mi - micronucleus, pr - pellicular ridge, s - scopula. Scale bars - 20 µm (**8**); 10 µm (**3, 4, 5,** 7); 1µm (**6**)

aboral region, and a small micronucleus is located close to the peristome.

In one population of *M. lusitana*, the macronucleus forms a band or is beaded (Cuénot 1891). Another population of *M. lusitana*, described by Madrazo-Garibay and López-Ochoterena (1988) from clams, has a horseshoe-shaped macronucleus adoral to the trochal band. *Mantoscyphidia ubiquita* has a sausage-shaped macronucleus, which is situated in the middle part of the body in expanded and partially contracted forms.

The position and shape of the nuclear apparatus of *M. fanthami* and *M. spadiceae* are similar, but *M. spadiceae* has a much larger macro- and micronucleus than those of *M. fanthami*. The scopula of *M. fanthami* is broader than its body (Basson *et al.* 1999), whilst in the case of *M. spadiceae,* it is as broad as the widest part of the body. As in the case of most of the species of *Mantoscyphidia*, except *M. littorinae*, constriction or narrowing is visible adoral to the scopula in *M. spadiceae*.

***Mantoscyphidia midae* sp. n. (Figs. 10-19)**

Type host and locality: *Haliotis midae*, Linnaeus, 1758, on gills; De Hoop Nature Reserve, south coast of South Africa (34°28'S; 20°30'E)

Type-specimens: holotype, slide 97/04/07-14 (NMBP 238) in the collection of the National Museum, Bloemfontein, South Africa, paratypes, slides 97/03/29-02 (NMBP 239), 97/03/29-09 (NMBP 240), hematoxylin stained, in the collection of the authors.

Etymology: named after the South African perlemoen *Haliotis midae*, on which the scyphidiid peritrichs occur.

Description

Body cylindrical (Figs. 10, 11, 16-18) narrowing toward peristome. Body length 65-150 (86.9 ± 15.9, 81) [81-110 (89.8 ± 8.8, 19)], body diameter 18-45 (28.3 ± 6.1, 81) [22-40 (29.8 ± 5.4, 19)] (Table 2). Peristomial disc ranging from flattened to arched, with broad lip (Figs. 11, 16, 17) where width depends on degree of body contraction. Peristomial apex prominent in expanded specimens (Figs. 16, 17). Scopula broad, flattened and prominent (Figs. 10, 13, 16), length 3-20 (9.1 ± 2.5, 81) [3-28 (10.3 ± 6.3, 19)], diameter 20-50 (34.5 ± 9, 81) [6-50 (32.6 ± 10, 19)].

Pellicular striations in expanded individuals approximately 0.25 µm apart (Figs. 14, 15), adorning whole body, including peristome and scopula. Striations evenly spaced and uniform. Bottom half of peristomial lip with uniform striation pattern in expanded specimens, upper half showing irregular pattern. In contracted individuals, edge of peristome indistinct with striations forming a zigzag pattern. Trochal band consists of four to eight closely associated striations (Table 3), forming slight elevations (Fig. 14). Warren (1991) refers to the trochal band as a slight constriction just above the scopular region of *Mantoscyphidia physarum*.

Adoral zone describes 450° (Fig. 12), before plunging into infundibulum (Fig. 19). Row of pores between ciliary spiral and peristomial lip present but not always prominent. Small buccal cavity. Buccal apparatus as follows: haplo- and polykinety starting almost at same point. Haplo- and polykineties divided by pellicular ridge or comb, approximately same width as a kinetosome. Polykinety three kinetosomes wide. Haplokinety plunges first into infundibulum (Fig. 19). Polykinety divides into infundibular polykinetids after plunging into infundibulum. Impregnable fibrillar structure associated with haplokinety. Both haplo- and polykinety make one turn (360°) inside infundibulum before reaching cytostome (Fig. 19). Cytostome not always clearly visible.

Cytoplasm granular (Figs. 10, 16-18). Contractile vacuole present, always in adoral part of body. Symbiotic algae (Figs. 10, 16, 17) found throughout cytoplasm, varying in number and size.

Nuclear apparatus situated aboral to trochal band, very close to scopula (Figs. 10, 18). Nuclear apparatus consists of single, large, round to ovoid macronucleus, length 10-25 (15.8 ± 4.4, 18) [9-31 (14.5 ± 5.7, 19)], diameter 13-30 (21.4 ± 5.3, 18) [13-41 (20.7 ± 7.3, 19)] and single, smaller, ovoid micronucleus, length 5-15 (8.1 ± 2.7, 25) [5-14 (7.5 ± 2.7, 19)], diameter 8-25 (13.6 ± 4.9, 25) [8-23 (12.8 ± 4.2, 19)]. Micronucleus always found aborally and closely associated with macronucleus. Macronucleus forming indentation, occupied by micronucleus. Nuclear apparatus appear to be surrounded by some granular cytoplasm and symbiotic algae (Figs. 10,16-18).

Remarks

Mantoscyphidia midae can be distinguished from the other species by differences in morphology of the nuclear apparatus, scopula and body.

Mantoscyphidia midae, M. marioni and *M. branchi* all have broad, prominent scopulas. *Mantoscyphidia midae* and *M. fischeri* have similar cylindrical body forms, but differ significantly in shape and location of the macronucleus. The latter has a sausage-shaped macronucleus situated in the adoral region of the body, compared to the macronucleus of *M. midae* that is compact

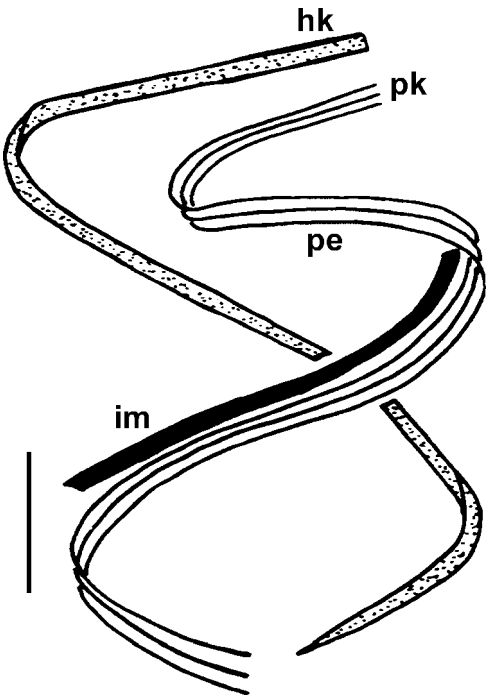


Fig. 9. Buccal infraciliature of *Mantoscyphidia spadiceae* sp. n. occurring on the gills of *Haliotis spadicea* Donovan, 1808, collected from the De Hoop Nature Reserve, South Africa. hk - haplokinety, im - impregnable band, pe - peniculus, pk - polykinety. Scale bar - 1 μm

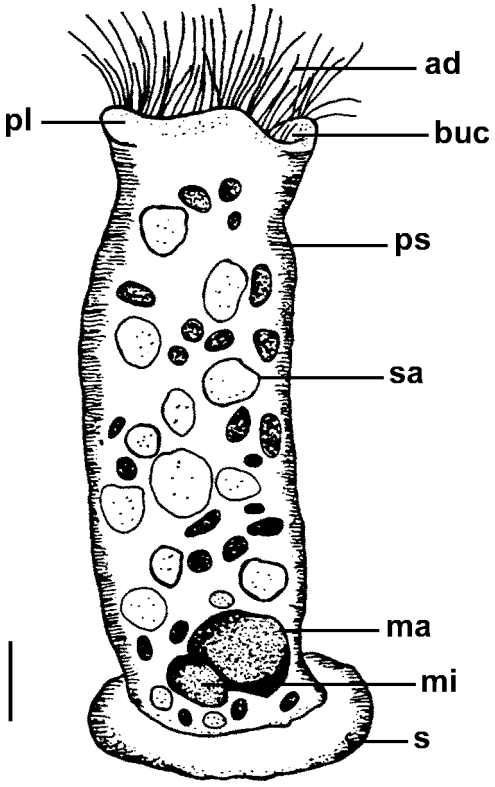


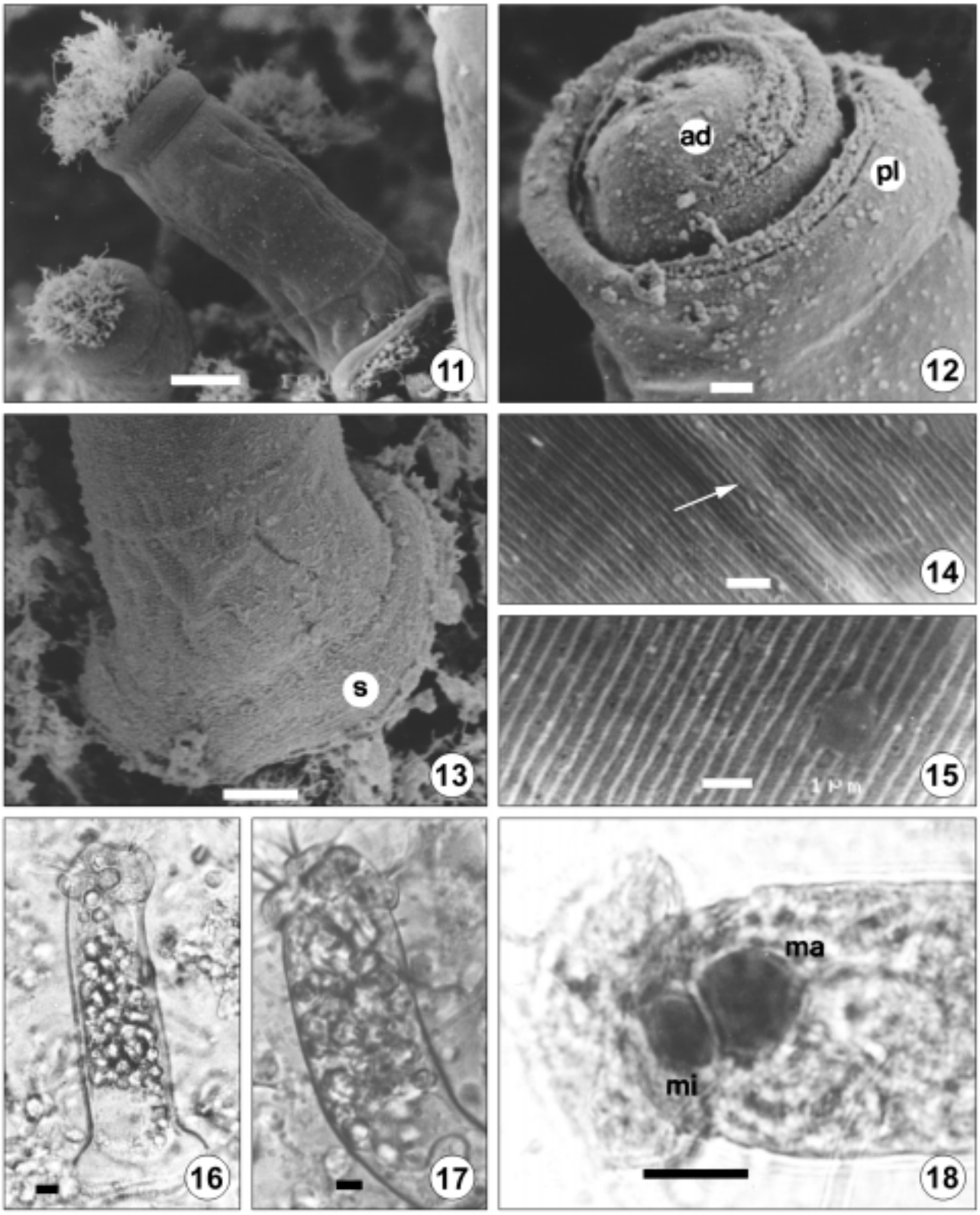
Fig. 10. Microscope projection drawing of *Mantoscyphidia midae* sp. n. occurring on the gills of *Haliotis midae* Linnaeus, 1758, collected from the De Hoop Nature Reserve, South Africa. ad - adoral ciliary spiral, buc - buccal cavity, ma - macronucleus, mi - micronucleus, pl - peristomial lip, ps - pellicle striations, s - scopula, sa - symbiotic algae. Scale bar - 10 μm

in shape and always found aboral to the trochal band. According to Raabe (1952), *M. littorinae* also has a prominent scopula, like that of *M. midae*, but its macronucleus is situated farther adorally from the scopula. Its micronucleus, however, is much smaller than its macronucleus, as is also the case in *M. midae*. *Mantoscyphidia fanthami* has the same cylindrical body form as *M. midae*, but is much longer (101.3 μm and 89.8 μm).

The body of *M. midae* does not widen towards its peristome, like that of *M. spadiceae* but narrows. Both live observations and measurements of hematoxylin stained specimens revealed *M. spadiceae* to have a greater body length than *M. midae* (compare Table 1 and 2). *Mantoscyphidia midae* has a smaller body diameter (28.3 μm), than that of *M. spadiceae* (31.2 μm), and a broader and flatter scopula in relation to body diameter. *Mantoscyphidia midae* also has a vesicular cytoplasm, and has a much higher occurrence of symbiotic algae occurring throughout the body rather than being restricted to the area adoral of the trochal band, as in *M. spadiceae*.

There are significant differences between the infundibula of *M. midae* and *M. spadiceae*, which can be used as distinguishing taxonomic characters (Figs. 9, 19). Furthermore, *M. midae* has striations that are spaced a bit closer together than those of *M. spadiceae*, therefore accounting for the greater total number of striations adorning the body (255.8 and 222.1), even though *M. spadiceae* has a greater average body length. It appears as if the trochal band of *M. midae* includes more striations.

Mantoscyphidia spadiceae has a definite cytoplasmic discontinuity situated adoral to the nuclear apparatus, thus separating the nuclear apparatus from the rest of the cytoplasm. This discontinuity is absent in *M. midae* and the nuclear apparatus appears to be surrounded with symbiotic algae and part of the granular cytoplasm, and thus not separate from the adoral cyto-



Figs. 11-18. Scanning electron micrographs (**11-15**) and photomicrographs (**16-18**) of specimens of *Mantoscyphidia midae* sp. n. occurring on the gills of *Haliotis midae* Linnaeus, 1758, collected from the De Hoop Nature Reserve, South Africa. **11** - expanded specimen attached to the gill arch; **12** - adoral zone describes 450°; **13** - broad, flattened scopula; **14** - trochal band indicated by arrow; **15** - body striations; **16, 17** - bodies expanded, peristomial discs arched, symbiotic algae distributed throughout body; **18** - hematoxylin stained specimen. ad - adoral ciliary spiral, ma - macronucleus, mi - micronucleus, pl - peristomial lip, s - scopula. Scale bars - 20 µm (**18**); 10 µm (**11, 13, 16, 17**); 1µm (**12, 14, 15**)

Table 1. Variation of body measurements (µm) of hematoxylin stained specimens of *Mantoscyphidia spadiceae* sp. n. occurring on the gills of *Haliotis spadicea* Donovan, 1808 from the De Hoop Nature Reserve, South Africa

	Completely contracted	Partially contracted	Fully expanded
Body length	49-60 (53 ± 4.7,11)	63-80 (72.9 ± 5.5,31)	82-134 (100 ± 12.7,47)
Body diameter	25-43 (34.3 ± 4.8,11)	23-56 (34.5 ± 7.5,31)	26-60 (42 ± 6.5,47)
Scopula length	3-12 (6.8 ± 2.8,11)	2-21 (8.1 ± 4.6,31)	1-24 (10.3 ± 6.1,47)
Scopula diameter	15-38 (27.5 ± 7.7,11)	19-41 (28.2 ± 5.1,31)	19-45 (30.2 ± 5.1,47)
Macronucleus length	8-18 (13.1 ± 3.6,11)	5-22 (14.8 ± 3.5,31)	11-27 (16.8 ± 3.9,47)
Macronucleus diameter	14-33 (20.6 ± 5.1,11)	16-31 (21.1 ± 3.5,31)	17-38 (25.8 ± 4.4,47)
Micronucleus length	4-10 (6.7 ± 1.7,11)	4-12 (8.4 ± 2.1,31)	3-15 (10.2 ± 2.2,47)
Micronucleus diameter	11-17 (12.9 ± 2.3,11)	10-24 (16.2 ± 3.7,31)	12-30 (21.1 ± 3.5,47)

Table 2. Variation of body measurements (µm) of hematoxylin stained specimens of *Mantoscyphidia midae* sp. n. occurring on the gills of *Haliotis midae* Linnaeus, 1758 from the De Hoop Nature Reserve, South Africa

	Completely contracted	Partially contracted	Fully expanded
Body length	45-60 (55.6 ± 4.3,36)	61-83 (69.5 ± 5.9,67)	81-110 (89.8 ± 8.8,19)
Body diameter	17-43 (23.6 ± 4.8, 36)	17-38 (24.9 ± 4.4,67)	22-40 (29.8 ± 5.4,19)
Scopula length	1-18 (5.1 ± 3.7,36)	1-14 (5.9 ± 3.4,67)	3-28 (10.3 ± 6.3,19)
Scopula diameter	13-34 (24.3 ± 5.3,36)	16-43 (27.5 ± 5.4,67)	6-50 (32.6 ± 10,19)
Macronucleus length	5-19 (11 ± 3.1,36)	7-18 (11.1 ± 2.2,67)	9-31 (14.5 ± 5.7,19)
Macronucleus diameter	11-27 (15.5 ± 3.6,36)	10-31 (16.2 ± 4.1,67)	13-41 (20.7 ± 7.3,19)
Micronucleus length	2-12 (5.2 ± 1.8,36)	3-10 (6 ± 1.2,67)	5-14 (7.5 ± 2.7,19)
Micronucleus diameter	7-15 (10.5 ± 2.1,36)	7-16 (10.1 ± 2,67)	8-23 (12.8 ± 4.2,19)

Table 3. Body striations of *Mantoscyphidia spadiceae* sp. n. and *M. midae* sp. n. occurring on the gills of *Haliotis spadicea* Donovan, 1808 and *H. midae* Linnaeus, 1758 from the De Hoop Nature Reserve, South Africa

Number of striations	*M. spadiceae*	*M. midae*
Peristome	19-30 (24.6 ± 3.6,10)	20-42 (26.8 ± 6.8,10)
Peristome to trochal band	92-136 (114.3 ±13.6,10)	127-167 (141.8 ± 11.6,10)
Trochal band	5-12 (7.7 ± 2.6,10)	4-8 (6.2 ± 1.5,10)
Trochal band to scopula	40-103 (58.9 ± 19.5,10)	50-83 (61.3 ± 12.4,10)
Scopula	9-22 (15.8 ± 4.7,10)	14-31 (22.5 ± 4.9,10)
Total number of striations	188-249 (222.1 ± 21.7,10)	238-312 (255.8 ± 23.7,10)

plasm as in the case of *M. spadiceae*. By comparison, *M. midae* specimens have smaller micronuclei than those of *M. spadiceae.* The sizes of their macronuclei do not differ significantly.

Mantoscyphidia spadiceae and *M. midae* do share some similarities, however. Both species have macronuclei that are similar in position and shape, are extremely contractile, and attach to the arch of a gill rather than between gill lamellae. In extremely high infestations, however, the individuals of both species were also observed attached to gill lamellae.

Intraspecific variation

Body measurements of the different stages of contraction for *M. spadiceae* stained material is summarised in Table 1. The shrinkage effect on the nuclear appara-

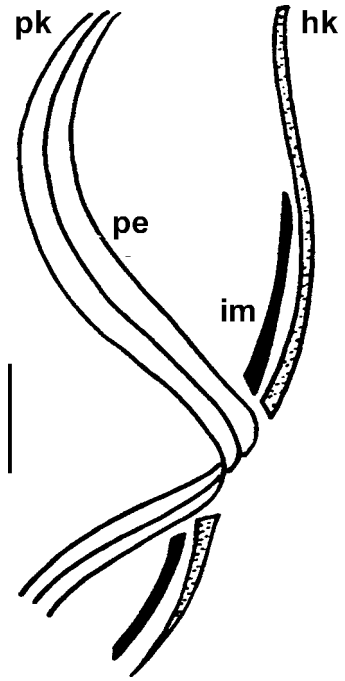


Fig. 19. Buccal infraciliature of *Mantoscyphidia midae* sp. n. occurring on the gills of *Haliotis midae* Linnaeus, 1758, collected from the De Hoop Nature Reserve, South Africa. hk - haplokinety, im - impregnable band, pe - peniculus, pk - polykinety. Scale bar - 1 µm

tus of live specimens vs. hematoxylin stained specimens is as follows: the arithmetic mean of the macronucleus length and diameter of live specimens (fully expanded) was 19.3 µm and 28.3 µm respectively, compared to 16.8 µm and 25.8 µm in hematoxylin stained specimens. This amounts to shrinkage of approximately 13 % and 9 %, respectively. The micronucleus length and diameter showed very little shrinkage between expanded hematoxylin stained and live specimens. Thus, macronucleus length is more affected by shrinkage, as was found in *M. branchi* (Van As *et al*. 1998). As in *M. branchi*, the form and position of the nuclear apparatus of *M. spadiceae* was consistent.

The arithmetic means of the body dimensions of expanded live specimens of *M. spadiceae* (Fig. 7) are slightly higher than those of expanded Bouin's fixed and hematoxylin stained specimens. This is not the case in *M. midae* (Table 2). This information confirms the necessity of including live observations in species descriptions. The body of *M. spadiceae* is extremely contractile, varying from 49 to 134 µm in length (Table 1). The body length of *M. spadiceae* is much greater than that of any other species in the genus, resembling most closely *M. ubiquita*, (body length 30 - 100 µm), and *M. fanthami* (body length 80-130 µm) (Hirshfield 1949, Basson *et al*. 1999).

The number of striations from different parts of the body, counted with the aid of SEM, can be used to describe new scyphidiid species (Van As *et al.* 1995). The number of striations for *M. spadiceae* and *M. midae* is presented in Table 3. Unfortunately this can only be compared to data of *M. branchi*, *M. marioni* and *M. fanthami* as no information on the number of body striations of the other species of *Mantoscyphidia* from marine gastropods is available. *Mantoscyphidia spadiceae, M. midae* and *M. fanthami* have an average total number of 222.1, 255.8 and 262 striations, respectively, whilst *M. branchi* and *M. marioni* have 106.5 and 115.6 striations respectively. This can be ascribed to the greater body length of *M. spadiceae* and *M. fanthami*, and the fact that in both of these species the striations are 0.3 µm apart, whilst in the case of *M. branchi* and *M. marioni* the striations are further (0.5 µm) apart. *Mantoscyphidia midae* has a shorter average body length, but the highest number of striations. This can be attributed to the fact that the body striations are only 0.25 µm apart.

In a comprehensive survey of 19 limpet species representing three genera along the South African coast, the scyphidiid peritrich, *M. branchi*, was found attached to the gills of specimens of all limpet species examined (Van As *et al*. 1998). Similarly, seven of the limpet species were infested with the same *Licnophora* Claparède, 1867 species, namely *L. limpetae* Van As, Van As & Basson, 1999. In a similar investigation of the limpet fauna from a Sub-antarctic Island in the Southern Ocean, one scyphidiid peritrich, *M. marioni* was found associated with the only limpet, *Nacella delesserti* (Phillips, 1849).

Parasitological surveys of the marine gastropod *Oxystele* Philippi, 1847 revealed the occurrence of one scyphidiid peritrich, i.e. *M. fanthami* on the gill filaments. This topshell genus comprises five species endemic to and distributed along the South African coast. *Mantoscyphidia fanthami* was found associated with all five species and occurred along the southern, western and eastern coastline (Basson *et al*. 1999). All the topshells were also infested with the same mobiline species, *Trichodina oxystelis* Sandon, 1965.

The two species in the genus *Haliotis* that were examined, namely *H. spadicea* and *H. midae*, were infested with two distinct species of scyphidiid peritrichs.

This is contrary to what has been found in southern Africa and can perhaps be attributed to the morphological and ecological differences that exist between the hosts.

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