

Aspects of the fine structure of female *Dinemoura latifolia* Steenstrup & Lütken, 1861 (Copepoda: Pandaridae): an SEM study

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The fine structure of the appendages of female *Dinemoura latifolia* Steenstrup & Lütken, 1861 was studied by means of scanning electron microscopy. This study was undertaken to gain an insight into the morphology of this ectoparasite. It is suggested that the function of the so-called adhesive pads is not adhesion as such, but rather the provision of support during attachment by means of the cephalothoracic sucker. Although most of the appendages are reduced to an apparently supportive function, the first antennae appear to have a significant sensory role.

Die fyn ultrastruktuur van die aanhangsels van *Dinemoura latifolia* Steenstrup & Lütken is bestudeer d.m.v. skandeerelektronmikroskopie. Die studie is gedoen ten einde 'n insig te kry in dié ektoparasiet se morfologie. Daar word voorgestel dat die sogenaamde vashegtings-kussings is eerder 'n ondersteuningsfunksie het gedurende vashegting aan die gasheer d.m.v. die sefalotorakale suier. Alhoewel die meeste aanhangsels gereduseer is tot ondersteuningsfunksies, het die eerste paar antennae klaarblyklik 'n belangrike sensoriese rol.

In spite of their distinctive habitus and marked characteristic features, Pandaridae have a long history of confusing descriptions, many of their species having accumulated long synonymies (Kabata 1979). In this regard, the genus *Dinemoura* Latreille, 1829, is no exception. It begins with the name of the genus, quoted wrongly as *Dinematura* (Burmeister 1835) and of course perpetuated thereafter, until Cressey (1967) once again decided on the original name.

Although the genus *Dinemoura* now contains four valid species, i.e. *Dinemoura producta* (Müller, 1785) (the type species of the genus), *D. discrepans* Cressey, 1967, the present species *D. latifolia* Steenstrup & Lütken, 1861 and a species of which the description 'defies comparisons' (Kabata 1979), *D. hamiltoni* Thomson, 1890, the type species has no less than 12 synonyms. The ultrastructure of the southern African species, *D. latifolia*, was studied by means of scanning electron microscopy in order to gain some insight into the morphology of this parasite.

The most recent review of the marine parasitic copepods from southern African coastal fish is that of Kensley & Grindley (1973). No mention is made of this genus in the text, although a record is given in a catalogue of material in the South African Museum, sampled from *Prionace glauca* (Linnaeus, 1758) and *Mola mola* (Linnaeus, 1758). All samples were taken from fish caught in Cape coastal waters. *D. latifolia* is the only southern African representative of this genus.

Materials and Methods

Specimens were obtained from the South African Museum in Cape Town, South Africa. Following cleaning in 1% sodium hypochlorite and an ultrasonic bath, dehydration was done in a graded series of ethanols. Critical point drying was done with CO₂, using amyl acetate as intermediate solvent. Specimens were sputter coated with gold and examined at 10 kV in a SEM.

Results and Discussion

The second segment of the first antenna contains a number

of smooth, short, stout setae (Figure 2a, b). The basal segment, however, lies ventrally under the frontal plates (Figure 2a) and contains three types of setae (Figure 2c). Lateral setae contain numerous setules, and are bottle-brush-like in appearance. Ventrally, one type contains short spines only on its ventral surface. The third type has a nodulated, rugose area ventrally (Figure 2d), which forms a central channel leading distally to a papilla with a central opening

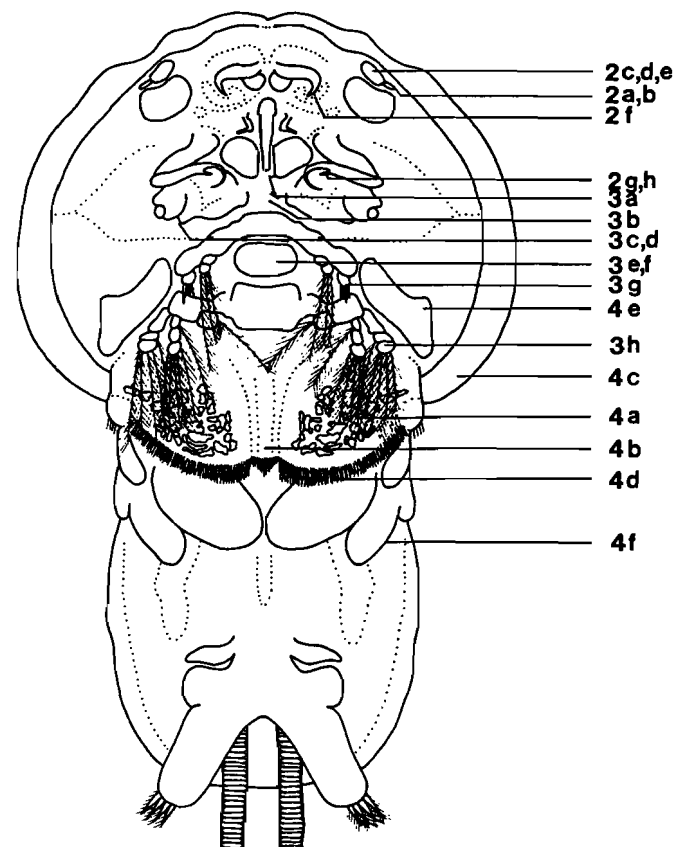


Figure 1 Schematic representation of *Dinemoura latifolia* with references to all other figures.

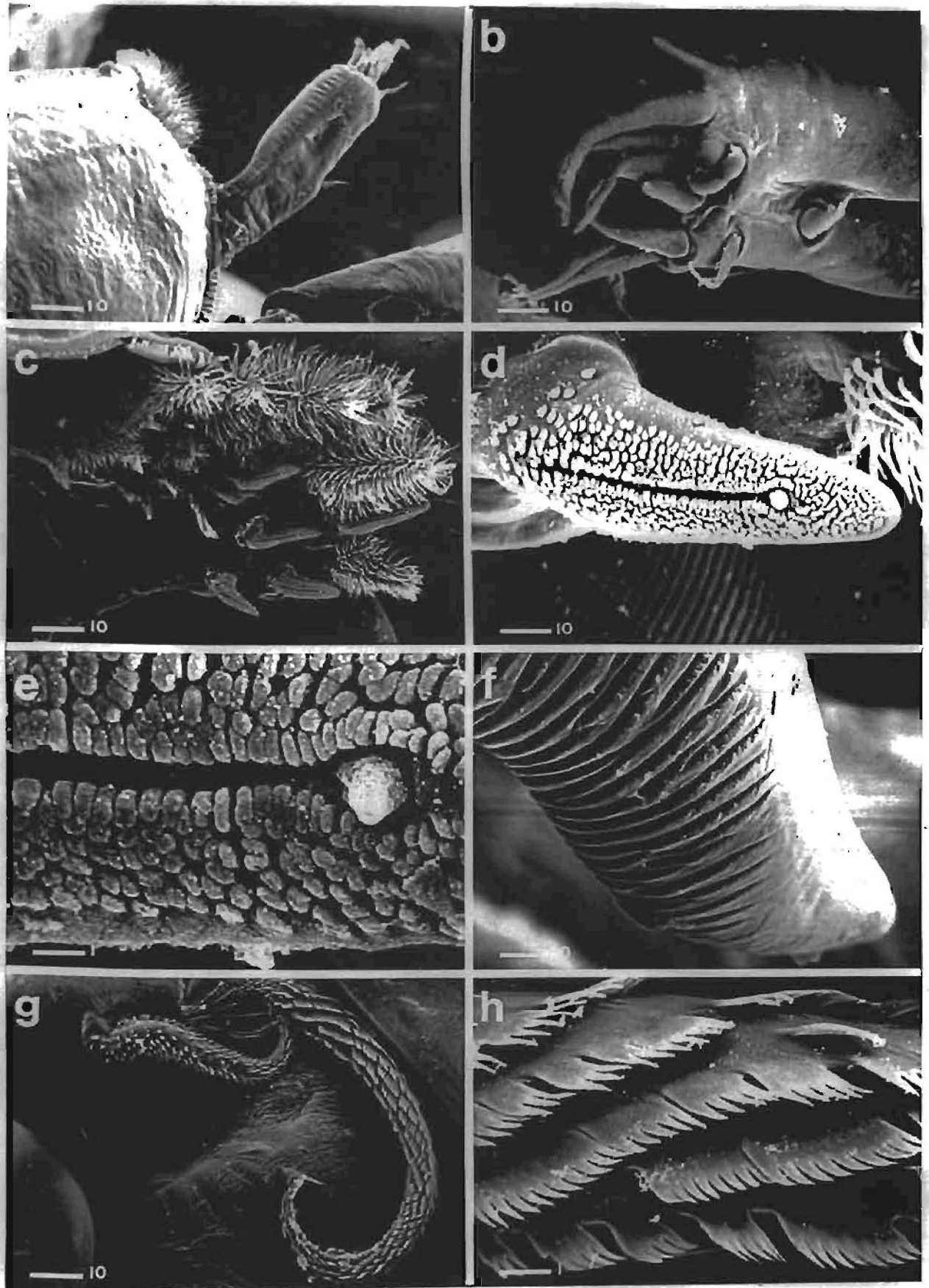


Figure 2 Scanning electron micrographs of the fine structure of *Dinemoura latifolia*. (a) Terminal segment of first antenna, dorsal, (b) tip of first antenna, (c) basal segment of first antenna, ventral, (d) rugose seta on first antenna's basal segment, (e) groove and presumed sensory opening on (c), (f) tip of second antenna, (g) second maxilla, ventral and (h) blade-like spines on terminal segment of second maxilla. (Measurements in μm .)

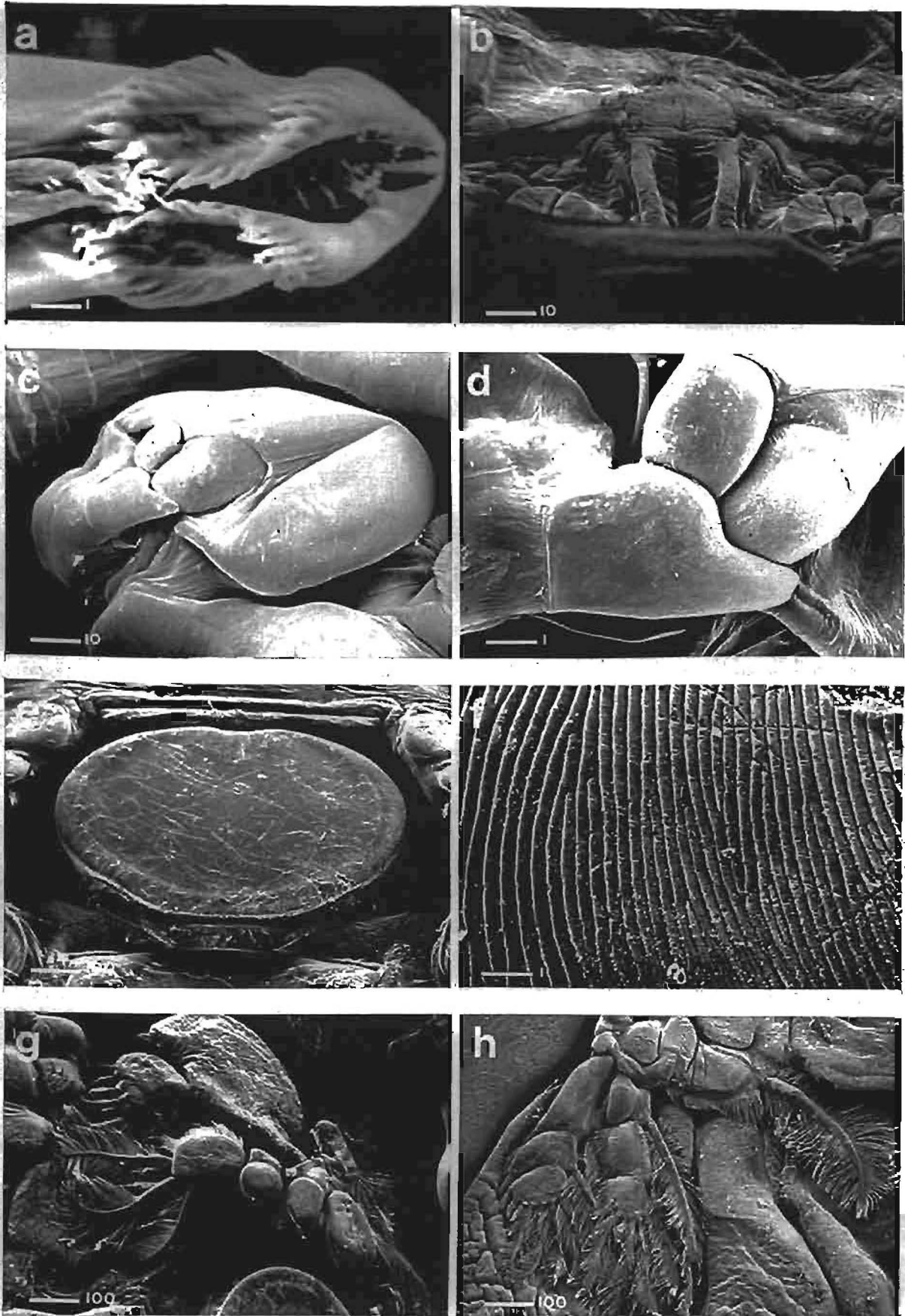


Figure 3 Scanning electron micrographs of the fine structure of *Dinemoura latifolia*. (a) Mouthtube, ventral, (b) frontal view of cephalothorax showing the cup-shaped cephalothorax and median, posterior groove in the pear-shaped structure between two rugose areas, (c) maxilliped, ventral, (d) same, showing two blunt processes and their articular areas, (e) central supportive pad directly posterior to interpedal plate of first pair of swimming legs, (f) fingerprint-like structure of supporting pads, (g) first swimming leg, ventral, and (h) second swimming leg. (Measurements in μm .)

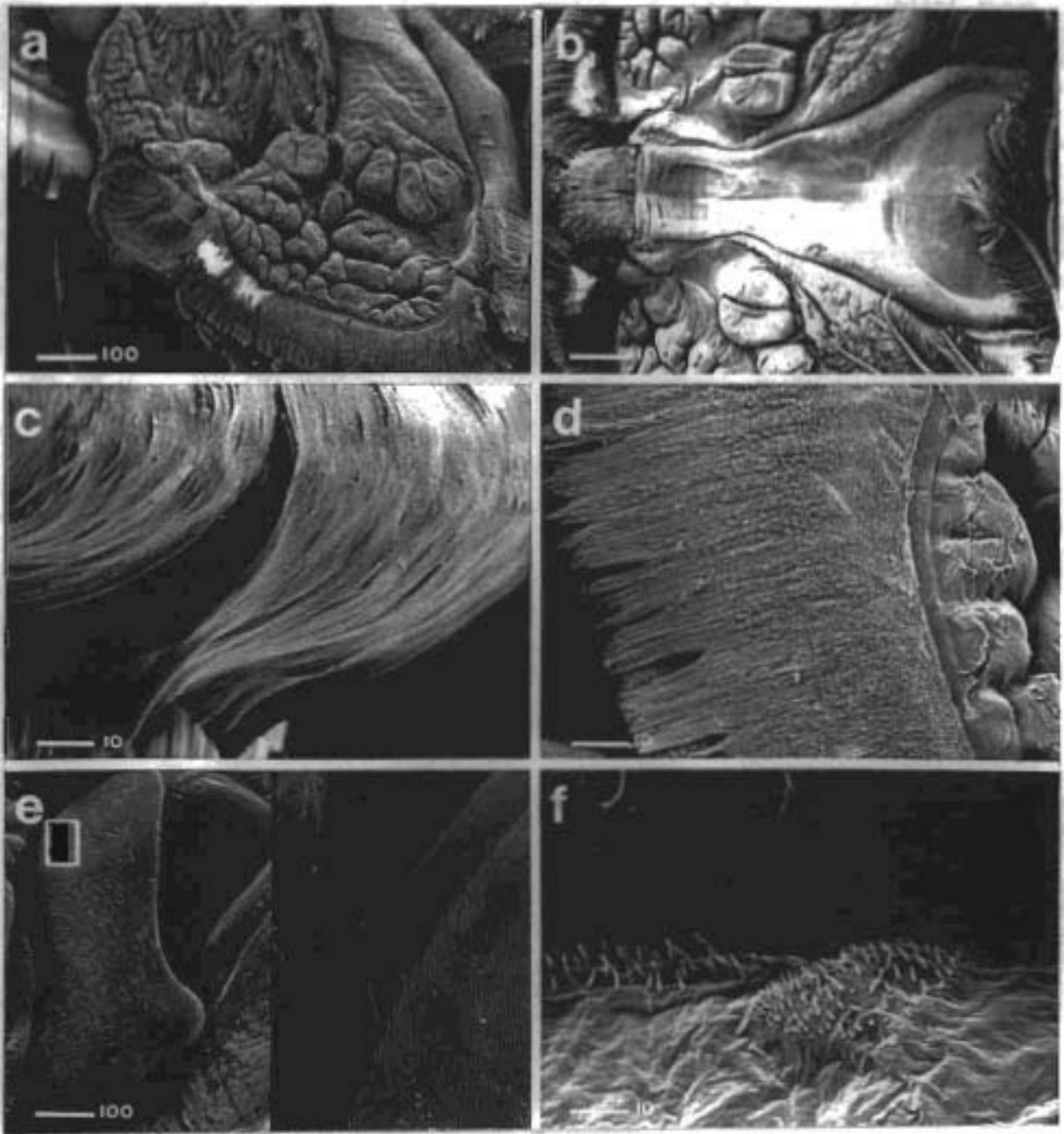


Figure 4 Scanning electron micrographs of the fine structure of *Dinemoura latifolia*. (a) Posterior-lateral rugose areas on cephalothorax, (b) median, pear-shaped structure between rugose areas in (a), (c) marginal membrane, (d) posterior sealing, thick, brushlike area on border of cephalothorax, (e) lateral supportive area with close-up of edge, (f) short spines on lateral edge of second ventro-lateral plate. (Measurements in μm .)

(Figure 2e). As far as we are aware this structure has not been found in other pandarids, but strongly suggests a sensory and/or adhesive function for this appendage. It furthermore serves as a support for the cephalothorax during attachment with the cephalothoracic sucker as seen in living specimens. The second antenna is curved medially (Figure 1) and smooth for the most part. Its adhesive function is verified by the presence of deep cuticular ridges on the ventral, i.e. inner, surfaces of the tips of the distal segments (Figure 2f).

The first maxilla is smooth and reduced as previously described (Cressey 1967). The second maxilla is long and

three-segmented. The short canna is covered by short, denticular spines (Figure 2g), which are not organized in rows, as described for *D. producta* (Kabata 1979). The tip of the second segment has a tuft of setae originating next to the terminal segment, which has spiral rows of flat, distally spined, overlapping layers of cuticula over its complete surface (Figure 2h). The dentiferous nature of the terminal segment of the second maxilla, together with its proximity to the mouthtube, suggests that this appendage is functional in collecting and moving food particles toward the opening of the mouthtube as stated previously by Kabata (1979).

The mouthtube is long and slender. The labrum, which is

shorter than the labium, has a bifid process which is folded back into the opening of the mouthtube. A row of stout spines is present on the labrum and appears to continue uninterrupted around the inside of the mouth opening to the labium (Figure 3a). The mandible is smooth with large, inwardly directed teeth. Both the labrum and labium are ventrally split and it has been observed in live specimens that as the mouthtube is pressed against the host tissue during feeding, both move laterally, thereby (a) enlarging the opening of the mouthtube and (b) bringing the mandible into closer and freer contact with the substrate.

The maxilliped consists of a bipartite process (Figure 3c) as described for *D. producta* (Kabata, 1979). The lateral arm ends in a movable, pointed tip, upon which two blunt processes of the medial process rest (Figure 3d).

A number of so-called adhesion pads (Cressey 1967) are present on the ventral surface of the cephalothorax: just posterior to the basal segment of the first antennae, on either side of the tip of the mouthtube, a central one (Figure 3e) directly posterior to the interpedal plate of the first pair of swimming legs and a pair of lateral, elongated pads (Figure 4e) antero-laterally to the second swimming legs (Figure 1). All pads, which I believe to be supportive rather than adhesive, share two characteristics. On close inspection a grooved pattern reminiscent of a fingerprint is present (Figure 3f, 4e), suggesting significant cuticular strengthening. All pads in all specimens examined showed superficial scarring (Figure 3e), suggesting that they remain close to the substrate during movement and are firmly pressed against it during attachment by means of the cephalothoracic sucker.

Such supportive pads are also present on the first three segments of the first swimming legs (Figure 3g), but not the second (Figure 3h). The swimming legs also appear dorso-ventrally flattened and can be carried in close contact with the cephalothorax. Just posterior to the extremities of the setae of the second pair of swimming legs there are rugose areas (Figure 4a). A medially depressed, pear-shaped structure is situated between these rugose areas (Figure 4b & 3b).

The mechanism of the cephalothoracic sucker has been discussed previously (Kabata & Hewitt 1971). A wide,

finely striated marginal membrane is present along the anterior and lateral margins of the cephalothorax of *D. latifolia* (Figure 1 & 4c), which no doubt forms an effective seal against the host tissue. Posteriorly, however, this membrane is discontinued and a thick, matted, multi-layered sealing surface is created by extremely fine bristles (Figure 4a), which are shorter ventrally and become progressively longer dorsally (Figure 4d). It serves as a posterior seal to ensure complete isolation of the ventral cephalothorax during attachment. The ventrolateral plates are generally smooth, except for the second, which has a large number of small spines along its lateral border (Figure 4f).

Although pandarids have frequently been described, figured and discussed very little effort has gone into ascertaining the true fine structure. Concerning the adhesive pads mentioned by Cressey (1967), the evidence presented here shows that neither an adhesive substance nor structure is present. It would therefore seem logical to refer to these structures as supportive in future. Regarding the functional aspects of the morphology of *Dinemoura*, our knowledge is sadly lacking, owing to the fact that the opportunity to study live specimens rarely presents itself. This is the result of the difficulty of sampling low numbers of parasites in off-shore fish populations. Such studies would, however, greatly enhance our understanding of the functional morphology of these parasites.

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