Microanatomy and ultrastructure of *Unela* sp., an interstitial acochlidian gastropod from Bermuda

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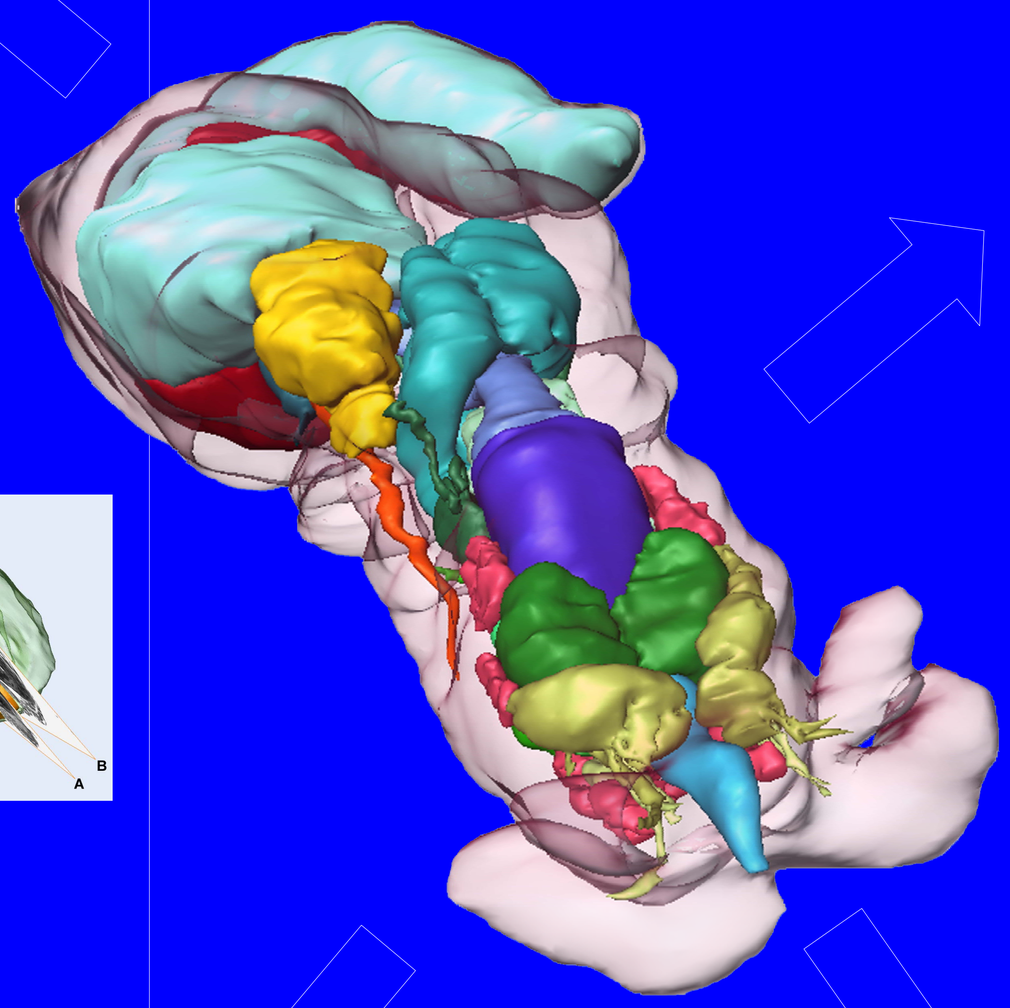
INTRODUCTION

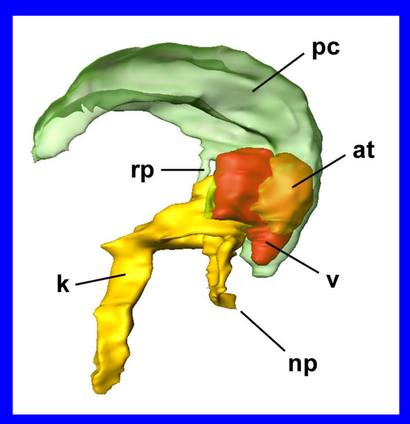
The Acochlidia are an enigmatic and poorly known opisthobranch group that is subdivided into the Hedylopsacea and Microhedylacea according to current classification. Previous studies b Fahrner & Haszprunar (2002) and Sommerfeldt & Schrödl (in review) already investigated the marine interstitial, hermaphroditic *Hedylopsis* sp. (Hedylopsidae) from the Red Sea as supposedly basal member of the Hedylopsacea. The present study uses *Unela* sp. (Microhedylidae) as a model organism of the Microhedylacea.

MATERIAL AND METHODS

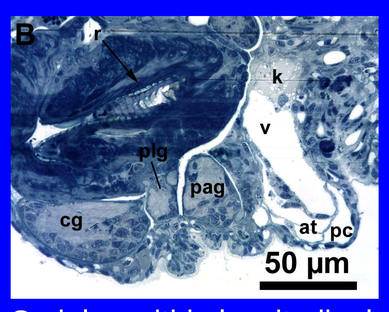
More than 20 specimens with up to 2 mm body length were extracted from coarse subtidal sand near Castle Roads, Bermuda Islands. Their central nervous, digestive, excretory, circulatory and genital systems were reconstructed 3-dimensionally from serial semithin histological sections using AMIRA software. The radula was analyzed by SEM, and ultrathin sections were made for analysis of the sperm strucuture by TEM.

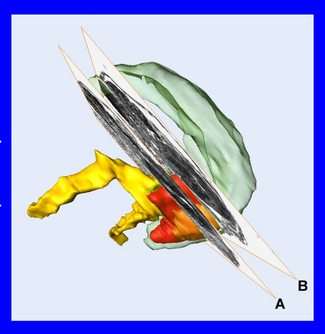


EXCRETORY AND CIRCULATORY SYSTEMS



Reconstruction (lateral view, specimen bent).

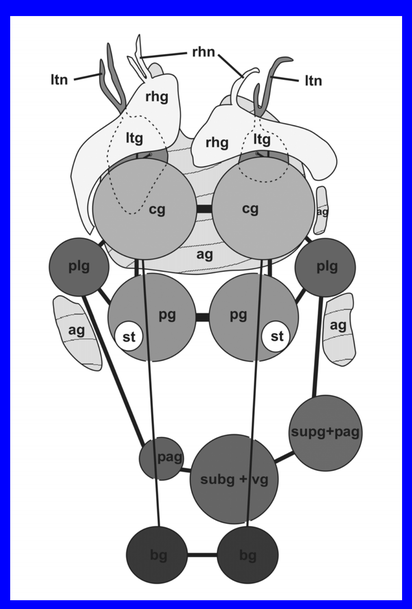




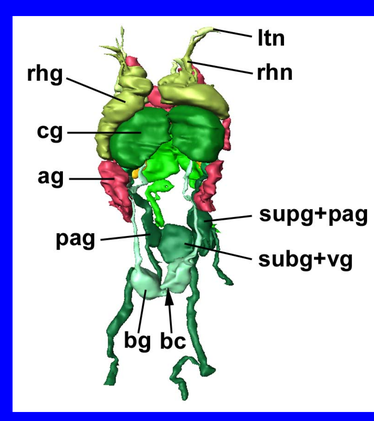
Serial semithin longitudinal sections.
A: renopericardial duct, heart, pericardium.
B: Heart, kidney.

at: atrium, **cg**: cerebral ganglion, **k**: kidney, **np**: nephroporus, **pag**: parietal ganglion, **pc**: pericardium, **plg**: pleural ganglion, **rp**: renopericardial duct, **v**: ventricle

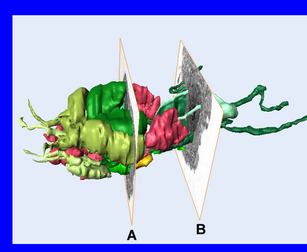
CENTRAL NERVOUS SYSTEM (CNS)

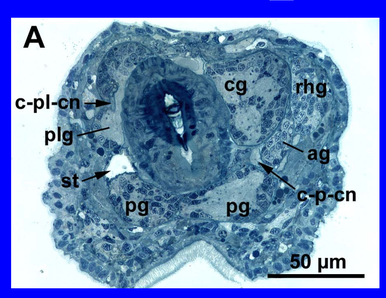


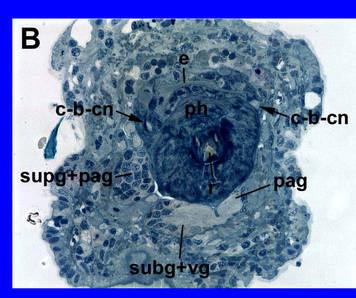
Scheme, dorsal view.



Reconstruction, dorsal view



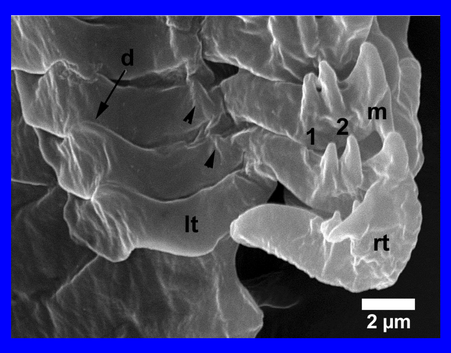




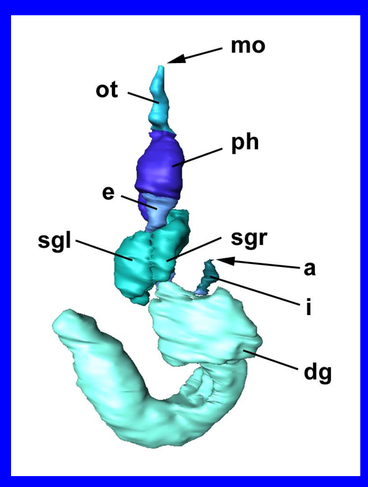
Serial semithin cross-sections.
A: Anterior cns. **B**: Visceral nerve cord.

ag: accessory „ganglion“, **bg**: buccal ganglion, **bc**: buccal commissure, **cg** cerebral ganglion, **c-b-cn**: cerebro-buccal-connective, **c-pl-cn**: cerebro pleural-connective, **e**: oesophagus, **ltg**: labial tentacle „ganglion“, **ltn**: labia tentacle nerve, **pag**: parietal ganglion, **pg**: pedal ganglion, **ph**: pharynx, **plg** pleural ganglion, **rhg**: rhinophoral „ganglion“, **rhn**: rhinophoral nerve, **st** statocyst, **subg**: subintestinal ganglion, **supg**: supraintestinal ganglion, **vg** visceral ganglion.

DIGESTIVE SYSTEM



Rhachidian and right lateral radula teeth.



Reconstruction, dorsal view.

a: anus, **d**: denticle of lateral tooth, **dg**: digestive gland, **e**: oesophagus, **i**: intestine, **lt**: oral tentacle, **m**: central cusp of rhachidian tooth, **mo**: mouth opening, **ot**: oral tube, **ph**: pharynx, **rt**: rhachidian tooth, **sgl**: left salivary gland, **sgr**: right salivary gland, **1,2**: lateral denticles, ▲ denticle or artifact?

REPRODUCTIVE SYSTEM

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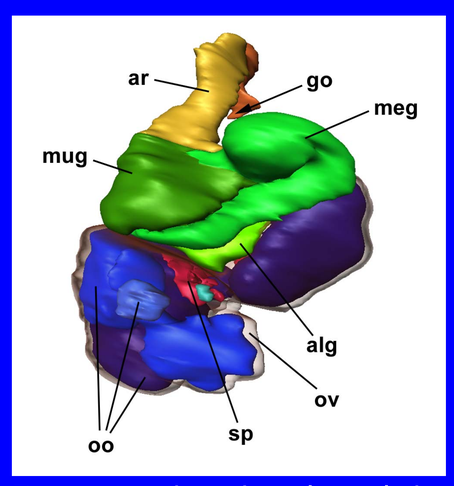
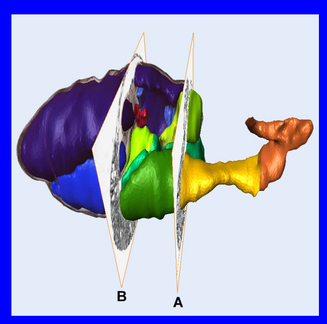
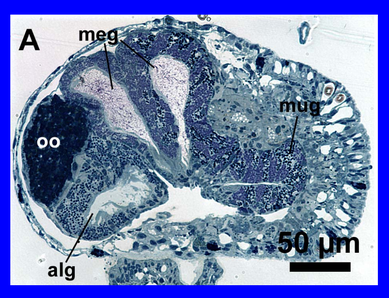


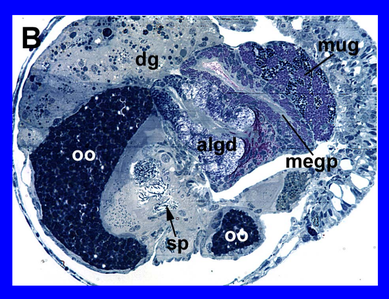
Reconstruction, dorsolateral view.



Serial semithin cross–sections.
A: Nidamental gland mass.
B: Oocytes, allosperm.

alg: albumen gland, **algd**: albumen gland, distal part, **ar**: adhesive region, **dg:** digestive gland, **go**: genital opening, **meg**: membrane gland, **megp**: membrane gland, proximal part, **mug**: mucous gland, **oo**: oocytes, **ov**: ovar, **sp**: allosperm.





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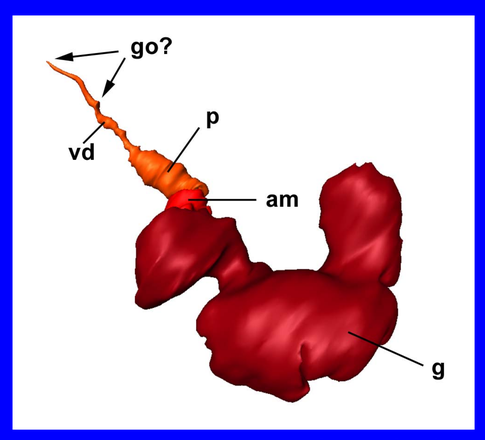
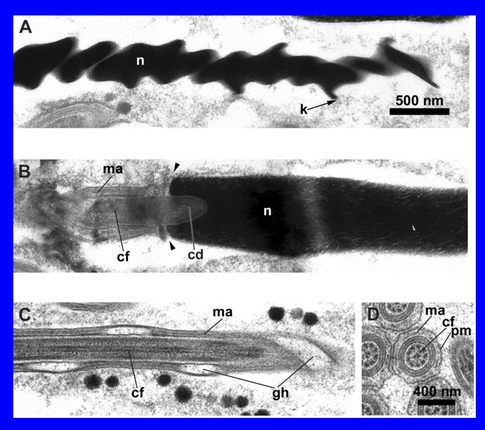


Reconstruction, ventrolateral, view.



Sperm ultrastructure (TEM).

A-C: longitudinal sections (scale bar 500 nm), D: cross–section (scale bar 400 nm).

A: keeled apical part of the nucleus. **B**: nucleus – midpiece - junction. **C**: Mitochondrial derivative with one glycogen helix. **D**: 2 x 9 + 2 microtubuli structure.

am: ampulla, **cd**: centriolar derivative, **cf**: central axoneme, **g**: gonad, **gh**: glycogen helix, **go**: genital opening, **k**: nuclear keel, **ma**: matrix, **n**: nucleus, **p**: prostate, **pm**: plasma membrane, **vd**: vas deferens, ▲ subnuclear ring.

CONCLUSIONS

1) The central nervous system of *Unela* sp. has numerous accessory „ganglia“. Rhinophoral „ganglia“ do not show a distinct medulla and cortex either. The arrangement of ganglia is, however, similar to that found in *Hedylopsis* sp. and may represent the usual condition within Acochlidia.

2) The excretory and circulatory systems of *Unela* sp. include a kidney and a two-chambered heart within the pericardial cavity. Remnants of a mantle cavity (as present in *Hedylopsis* sp.) could not be detected.

3) *Unela* sp. possesses a simple digestive system with large salivary glands, a holohepatic digestive gland and a symmetric radula. The radula formula is 38-39 x 1.1.1.

4) In contrast to *Hedylopsis* sp., sexes are separated in *Unela* sp.. With up to 180 µm, the yolky oocytes are large in relation to body size. Sperm is spindle – shaped, showing a keeled nucleus in the head and only one glycogen helix in the midpiece (3 in *Hedylopsis sp.*).

ACKNOWLEDGEMENTS

We would like to thank Dr. Bernhard Ruthensteiner and Sabine Schopf (both ZSM) for their introduction into AMIRA software, and Enrico Schwabe (ZSM) for his help with SEM examinations. Alexander Fahrner helped collecting and sorting specimens. Our gratitude goes to Dr. Wolfgang Sterrer for hospitality at the Bermuda Aquarium.

REFERENCES

Fahrner, A. & Haszprunar, G. 2002. Microanatomy, ultrastructure, and systematic significance of the excretory system and mantle cavity of an acochlidian Gastropod (Opisthobranchia). *Journal of Molluscan Studies*, **68**: 87-94.

Sommerfeldt, N. & Schrödl, M. In review. Microanatomy of *Hedylopsis ballantinei*, a new interstitial acochlidian gastropod from the Red Sea, and its significance for phylogeny.