

Gastrotricha

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The Gastrotricha are meiofaunal aschelminthes mostly occurring in marine sands and in lentic freshwaters.

Basic Design

External features

The phylum or subphylum Gastrotricha consists of small, mostly 75–1000 µm long, invertebrates which are ribbon or skittle shaped in dorsal view (**Figure 1**), flat on the underside and with an arched upper surface. Head and trunk regions are sometimes visible externally. Two or more adhesive tubules, sometimes arranged in groups, project from the general body outline. There are numerous external cilia; the ventral ones provide the main means of locomotion although leech-like progression is occasionally used. Sensory bristles occur, particularly near the anterior end and in association with adhesive tubules. Some species have epidermal spines, plates or scales. There is an anterior or antero-ventral mouth and a ventral subterminal anus.

Internal features

There is a through gut consisting of a muscular pharynx, triangular in cross-section, and a hind gut. A circulatory system is absent. There are some intracellular spaces, and the phylum has usually been thought of as pseudocoelomate although sometimes regarded as having a true, much reduced coelom. There are frontal nerve ganglia joined by a pharyngeal commissure and a pair of ventro-lateral nerve tracts. The excretory organs are protonephridial. Most marine gastrotrichs are simultaneous hermaphrodites; some species may have accessory sexual organs functioning for sperm intromission, reception or storage. Many freshwater species are parthenogenetic, a few have vestigial testes.

Ultrastructure

Ultrastructural studies have advanced our understanding of the phylogeny of lower invertebrates considerably. Two apparently unique features of the Gastrotricha are (1) that the outer tegument consists of a lamellar layer composed of sheets of unit-membrane-like structures overlying the basal layer, which often exhibits an outer striated zone, and (2) that the external cilia are all enclosed by the lamellar layer. Other features of interest are that there is cross-striation of muscle cells, that there are microvilli and pinocytotic vesicles associated with at least some of the cilia's basal pits, that epidermal cells in some gastrotrichs are

Introductory article

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monociliated and that most adhesive tubules are duoglandular consisting of an adhesive producing cell, a releaser producing cell and a sensory, typical 9+2 structured, cilium enclosed in a common tegumentary sheath (**Figure 1**).

Diversity and Lifestyles

In the thirty years between 1960 and 1990 the number of known gastrotrich species more than trebled as interest in marine meiofauna grew, although freshwater studies on the group remained fairly static. There have been few studies other than in Europe and the United States of America so the present known species number (about 500), represents only a fraction of the total living species. In marine sands gastrotrichs are often the third or fourth most dominant meiofaunal group with densities exceptionally reaching over 1000 beneath 1 cm² of the surface; grain size is a controlling factor. In freshwater habitats they are sometimes abundant in sands and gravels, on organic debris, on vegetation, especially moss, and in temporary pools. Occurrence tends to be very patchy over distances of a few centimetres even in apparently homogeneous habitats. Closely related species can occur in close proximity and habitat partitioning is not understood but may relate to food availability and factors such as oxygenation. Gastrotricha are microphagous; food includes bacteria, ciliates and diatoms. There is evidence for epidermal uptake of dissolved organic matter. In most marine forms food is taken from sand grain surfaces or from the interstitial water by pharyngeal sucking action; many freshwater species concentrate food particles by ciliary action. Little is known of predation on gastrotrichs but marine species are eaten by various small predators such as turbellarians and by deposit feeders such as lugworms; freshwater forms are taken by some microphagous fish. Lifespan is thought to vary from a few weeks to a few months. Development is direct and population increase can be very rapid.

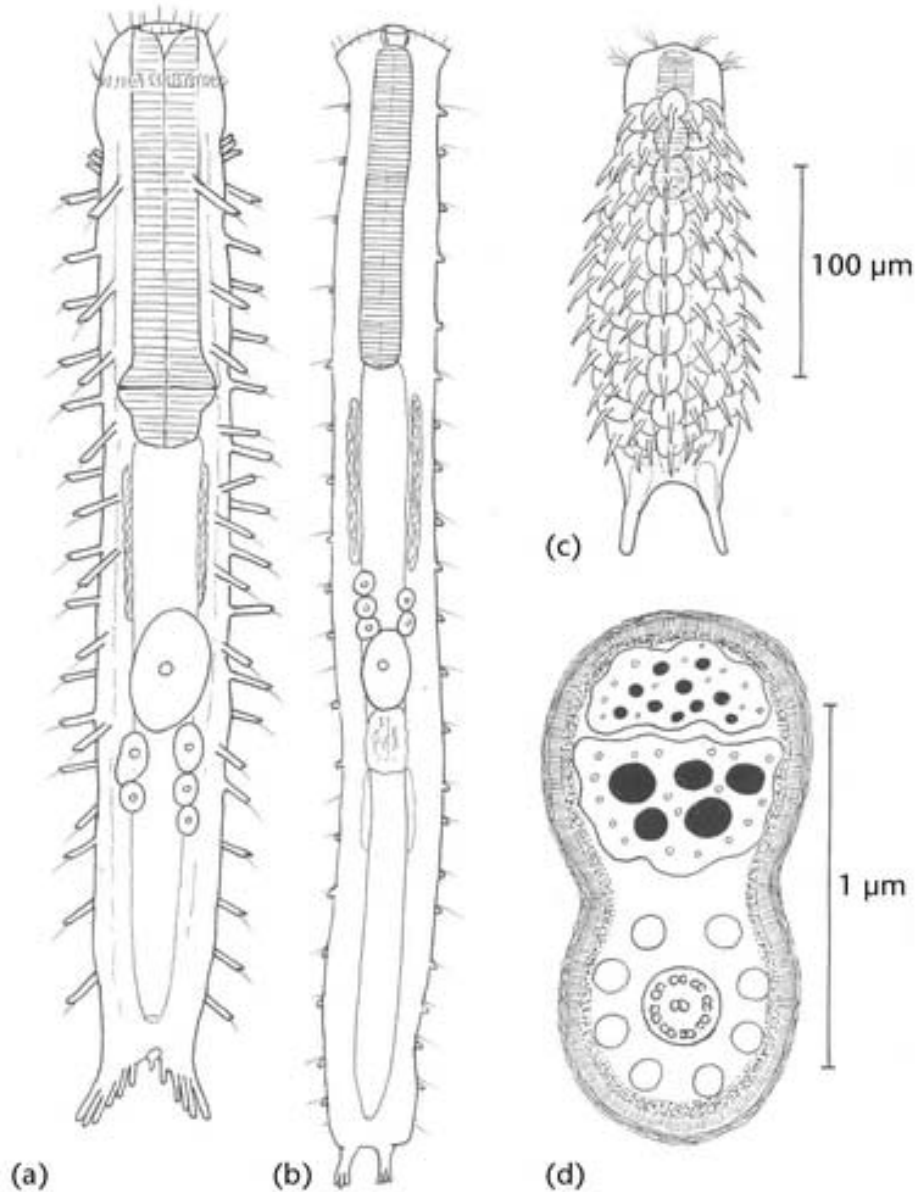


Figure 1 Gastrotricha. General appearance and ultrastructure. (a) A macrodasyid *Turbanella* sp.; (b) a paucitubulatinid *Neodasyis* sp.; (c) a multitubulatinid *Chaetonotus* sp.; all dorsal view and to upper scale; (d) diagram of electron microscope transverse section of *Turbanella* adhesive tubule showing outer lamellae, tegument with striated and granular layer, cilium and microvilli of sensory cell, adhesive cell with large secretory droplets and releaser cell with small droplets.

Fossil History and Phylogeny

There is no known fossil evidence of Gastrotricha. This is probably due to their small size and general lack of hard parts. Therefore, at present, the time of origin of the phylum can only be inferred or guessed. At least one 'ascelminth' phylum – the Priapulida – has clear Cambrian

occurrence and some evidence suggests that nematodes were established by the late Precambrian.

The general body plan, particularly the structural details of the pharynx and the cuticle, indicates a close relationship between the Gastrotricha and the Nematoda, gastrotrichs being the most plesiomorphic group. There is some evidence pointing to a possible relationship with the

Gnathostomulida, namely the latter's cross-striated musculature, bilateral symmetry of the pharynx, monociliary epithelium and ultrastructure of the protonephridia (plus the occasional anal pore of some gnathostomulid species).

Customarily the Gastrotricha are presented as having two orders, the marine Macrodasyida and the mainly freshwater Chaetonotida.

The chaetonotids have two suborders; in both the pharynx lumen is Y-shaped, as in the Nematoda, and all species lack pharyngeal pores. In the Multitubulatina there are several lateral adhesive tubules plus several tubules on a pair of posterior pedicles, and the tegument lacks scales or spines; in the Paucitubulatina there is a single or, rarely, a double pair of posterior tubules only and there are usually many spines or scales. It is probable that the Paucitubulatina really represent a third order. In macrodasyids the pharynx lumen is of inverted Y shape and there are usually a pair of lateral pharyngeal pores and numerous adhesive tubules.

It has been suggested that the Gastrotricha originated in the Precambrian in fine- to medium-grained marine sands, these having remained the dominant macrodasyid habitat. Invasions of freshwater estuarine, subterranean or phreatic habitats occurred at some later date.

Further Reading

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