

# Gnathostomulida (Unsegmented Marine Worms)

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Introductory article

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Gnathostomulida are microscopic, free-living, unsegmented, entirely monociliated marine worms most likely related to Rotifera, Acanthocephala and Micrognathozoa.

## Basic Design

First described as an aberrant taxon of turbellarian flatworms by Peter Ax in 1956, Gnathostomulida were recognized as a distinct phylum by R.J. Riedl in 1969; W. Sterrer, in 1972, proposed the currently used classification. The phylum comprises two orders, Filospermoidea and Bursovaginoidea, the latter divided into two suborders, Scleroperalia and Conophoralia. Worm-shaped, and ranging from 0.3 to 3 mm in length, gnathostomulids differ from all known invertebrates in having an entirely monociliated epidermis, i.e. each epidermal cell carries only a single cilium. They are further distinguished by the possession of a bilaterally symmetrical pharynx that usually contains complex cuticular mouthparts consisting of paired jaws and an unpaired, ventral basal plate. The gut is straight and, unusually, lacks an anus. There are paired sensory organs, mainly in the form of bundled cilia at the anterior end, and excretory organs in the form of paired groups of protonephridia. Respiratory and circulatory organs are lacking. There is little or no 'body cavity', and the group is usually regarded as acoelomate or perhaps, pseudocoelomate. **See also:** Cilia and flagella

All gnathostomulids are hermaphrodites (**Figure 1**). The unpaired, pear-shaped ovary lies dorsally, between the gut and the epidermis, extending from behind the pharynx to about mid-body region. The germinal zone is located anteriorly, and size, maturity and yolk content of oocytes increase caudally during oogenesis. A single mature egg usually takes up the posterior-most half or two-thirds of the ovary. Testes are located in the posterior body part; they are paired in Bursovaginoidea and most Filospermoidea, and unpaired, located dorsal to the gut, in Conophoralia. Filospermoidea, and probably Conophoralia, have a simple, rosette- or funnel-shaped penis that is weakly muscular but richly glandular. Located posteriorly to the testes, it empties into a subterminal ventral pore. Scleroperalia are characterized by a bulbous, muscular penis which usually surrounds a tubular penis stylet made up of 8–10 rod-shaped cell extensions. There are three types of sperm whose homology is uncertain: (1) filiform sperm (with a spiral nucleus, a middle piece, and one 9+2

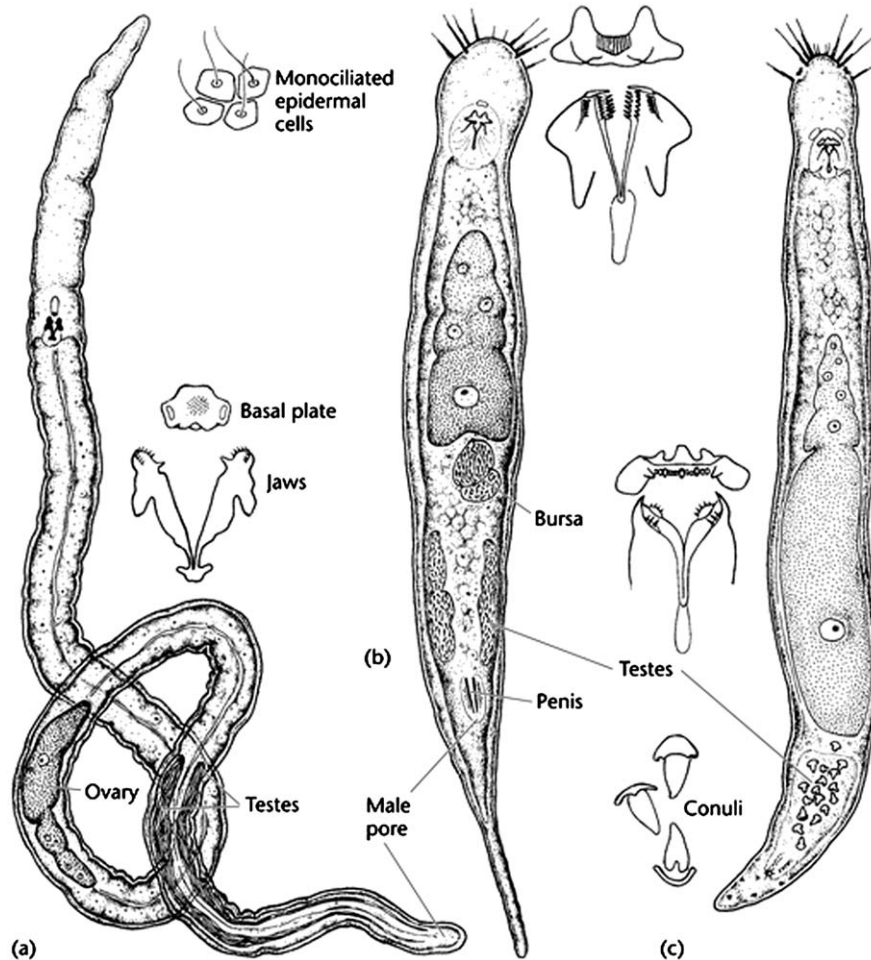
axoneme) in Filospermoidea, (2) aflagellate 'dwarf' sperm in Scleroperalia and (3) 'conulus' sperm in Conophoralia. Filiform sperm are able to move and rotate like a corkscrew whereas dwarf sperm and conuli are immotile. **See also:** Reproduction and life cycles in invertebrates

Sperm transfer is by copulation. Filospermoidea lack a vagina and a bursa for sperm storage; it seems that sperm are injected under the epidermis, and then distributed throughout the body where they are stored prior to use in fertilization. Most Conophoralia have a permanent vagina situated dorsally behind the ovary; the vagina leads into a pouch-shaped bursa in which usually only one or two sperm are stored. Scleroperalia lack a permanent vagina, but are characterized by a bursa system consisting of a caudal, rounded prebursa which connects anteriorly to a conical bursa. The wall of the bursa is composed of flattened cells which meet laterally to form crests, and anteriorly to form a perforated mouthpiece through which stored sperm are channelled to the mature egg. **See also:** Sperm–egg interactions: sperm–egg binding in invertebrates

Oviposition, at least in Scleroperalia, is by rupture of the dorsal epidermis behind the ovary and bursa, at the spot where a vagina may be located. The egg then becomes spherical and sticks to sand grains. Development is direct. Cleavage, still insufficiently known, seems to be of the spiral type, with yolk-rich zygotes undergoing gastrulation by epiboly (spreading of the ectoderm), resulting in a juvenile that lacks jaws but has a rudimentary pharynx.

## Diversity and Life Styles

Found exclusively in the interstices of shallow marine sand bottoms, from the intertidal to 400 m depth, the phylum currently comprises fewer than 100 species of which many have worldwide distribution. Although Gnathostomulida are frequently the dominant invertebrate taxon in the detritus-rich, sulfide-rich and oxygen-poor sands in which they typically occur, our knowledge of their biology is still scanty. It is assumed that they feed by grazing on the microflora (bacteria, fungal hyphae) that coats sand



**Figure 1** Representatives of the three major taxa of Gnathostomulida. (a) Filospermoidea (*Haplognathia rosea*); (b) Scleroperalia (*Gnathostomula peregrina*); (c) Conophoralia (*Austrognathia microconulifera*). (Adapted from Sterrer, 1986.)

grains, and that they have extremely low oxygen requirements, in addition to mechanisms for sulfide detoxification. **See also:** Ecology of invertebrate nutrition

## Fossil History and Phylogeny

Gnathostomulid evolution most likely progressed from the filospemoid condition (sperm with one 9 + 2 flagellum, no bursa, and a simple male pore) to the bursovaginoid condition (sperm aflagellate, bursa system present and a complex copulatory organ). In the absence of a fossil record, phylogenetic relationships are still quite open-ended. Ax suggested uniting Gnathostomulida and Platyhelminthes (flatworms) as sister groups in the taxon Platyhelminthomorpha, at the base of Bilateria, whereas other workers pointed out possible relationships with aschelminths such as Gastrotricha and Rotifera. Based on 18S ribosomal deoxyribonucleic acid (rDNA) analysis and morphological

characters, Gnathostomulida now appear most closely related to Syndermata (Rotifera and Acanthocephala) and the recently described Micrognathozoa. **See also:** Acanthocephala (thorny-headed worms); Platyhelminthes (flatworms); Rotifera

## Further Reading

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