

# Gastrotricha

## Systematics and Biology of A Meiobenthic Taxon



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# Outline

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- Position of Gastrotricha in the Animalia
  - How to recognize a gastrotrich
  - Life cycles and reproductive biology
  - Systematics
  - Methods: collections, morphological and molecular techniques
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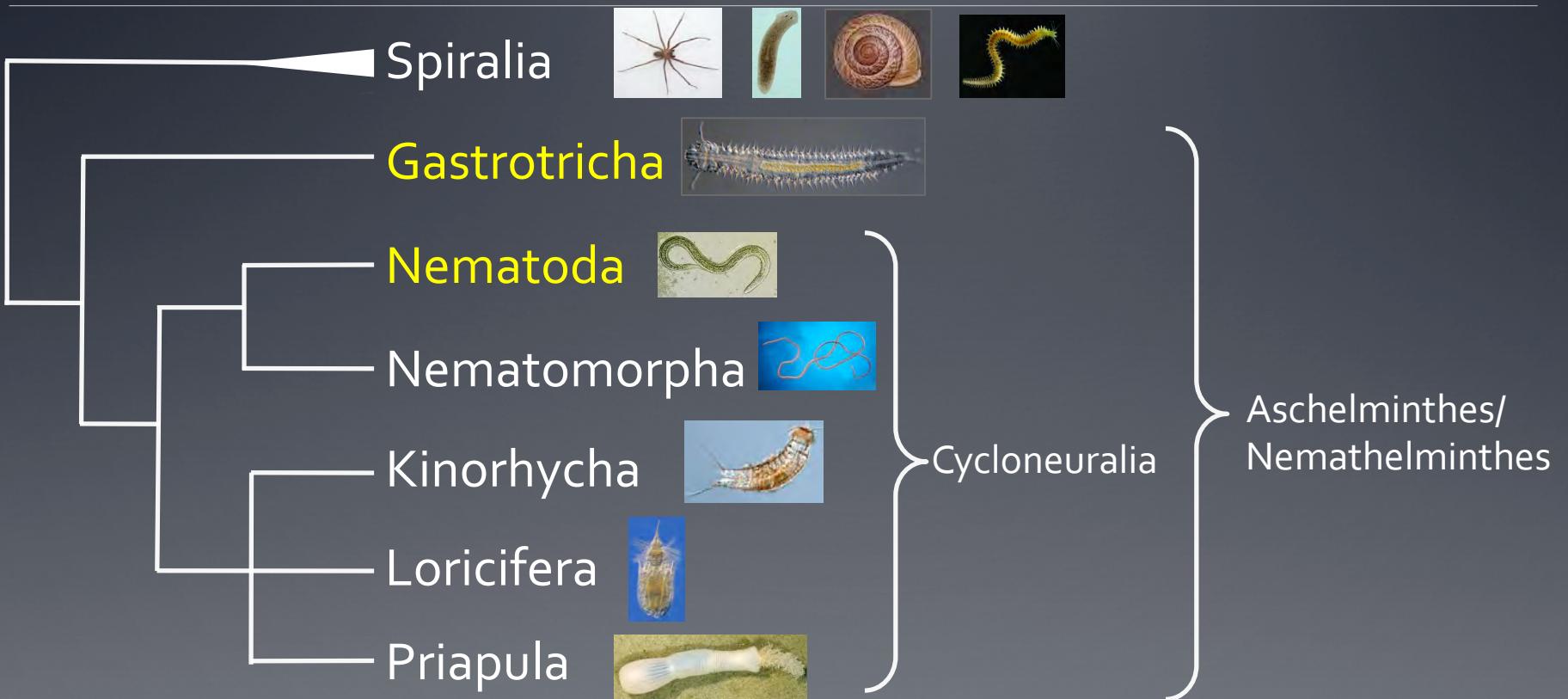
# Gastrotricha

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Phylum of ~900 species – about 500 are marine



# Phylogeny – Morphology



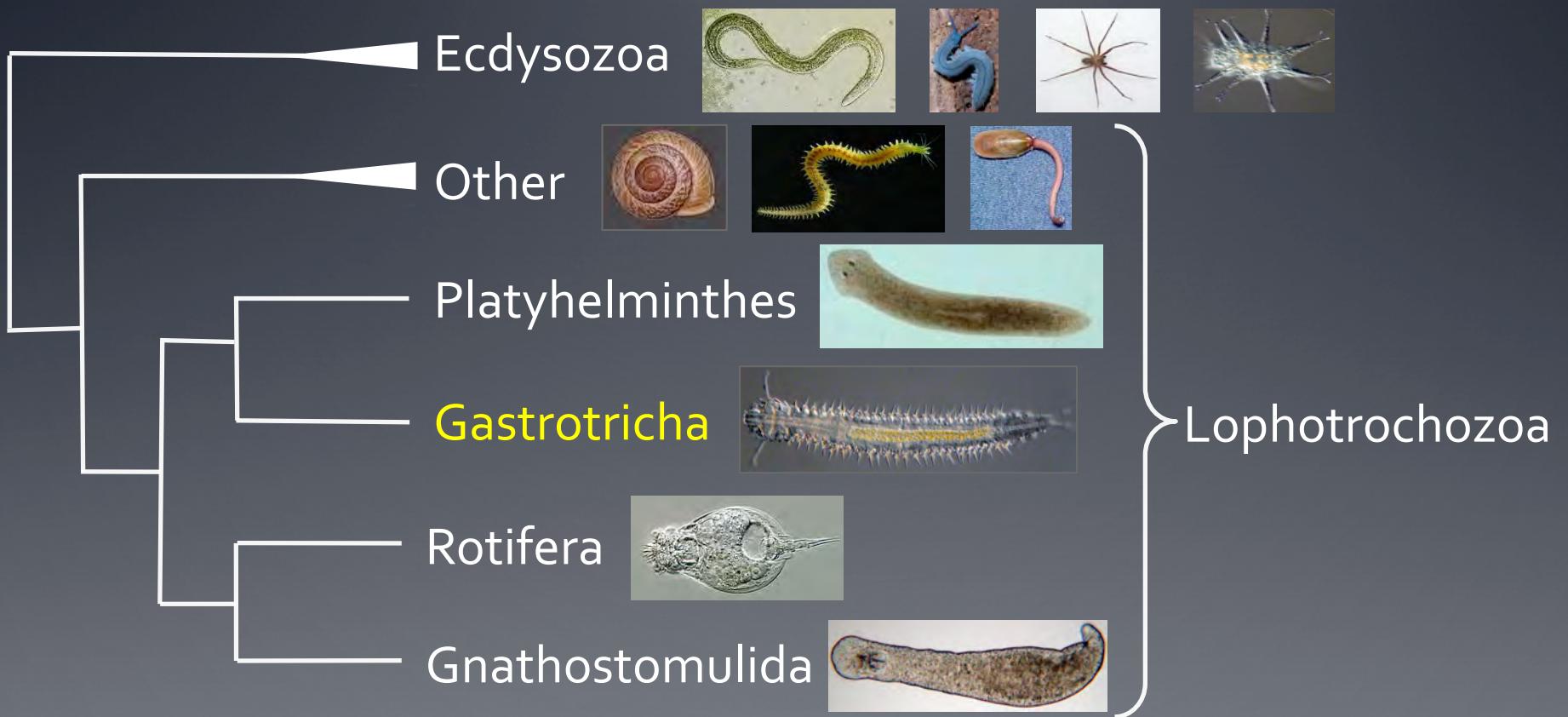
\*\*Consensus following Ahlrichs (1995), Nielsen (1995), Schmidt-Rhaesa 2002

# Position in the Animalia (18S, 28S)



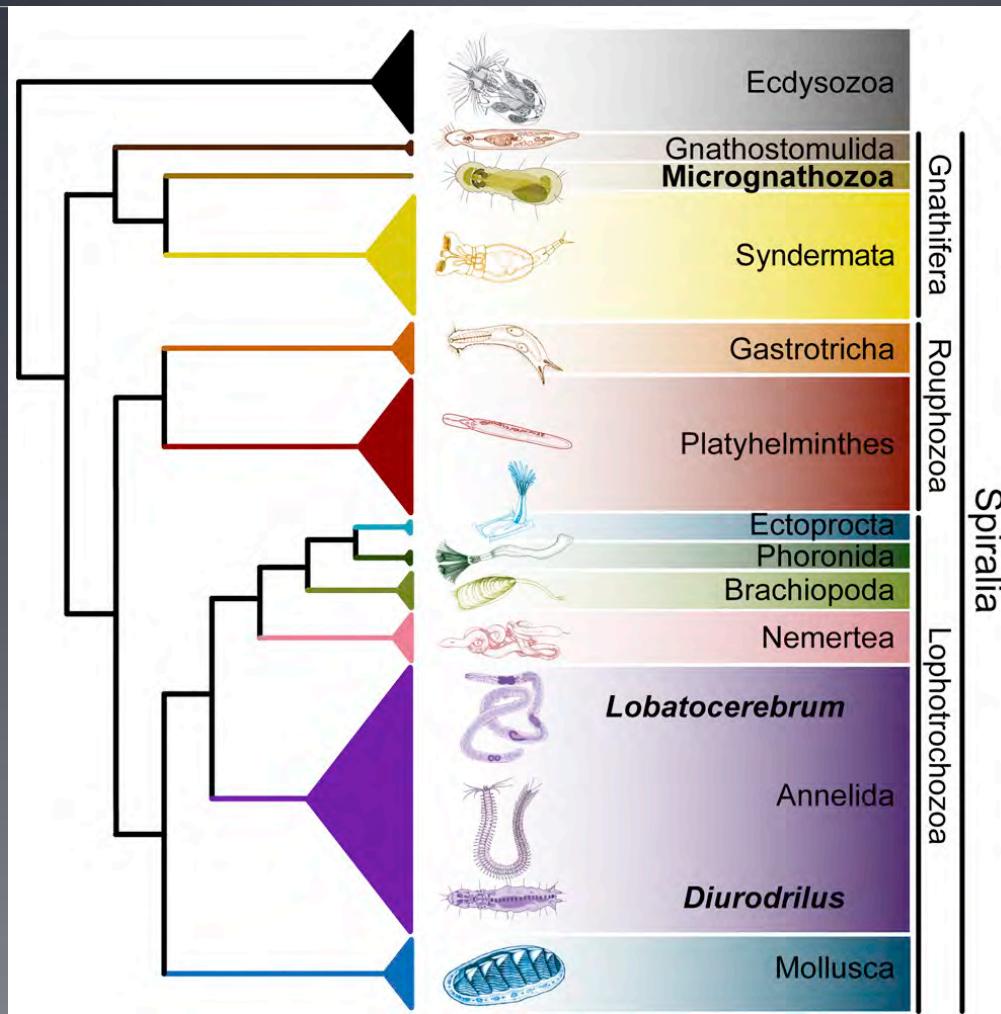
\*\*Consensus following Petrov et al (2006), Todaro et al (2006) and Paps et al (2009)

# Phylogeny – EST



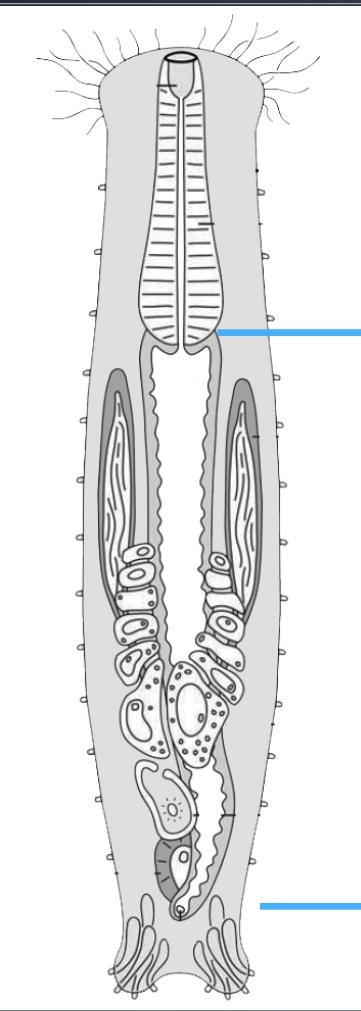
\*\*Dunn et al (2008)

# Phylogeny – Transcriptomic & Genomic Data (Laumer et al. 2015)



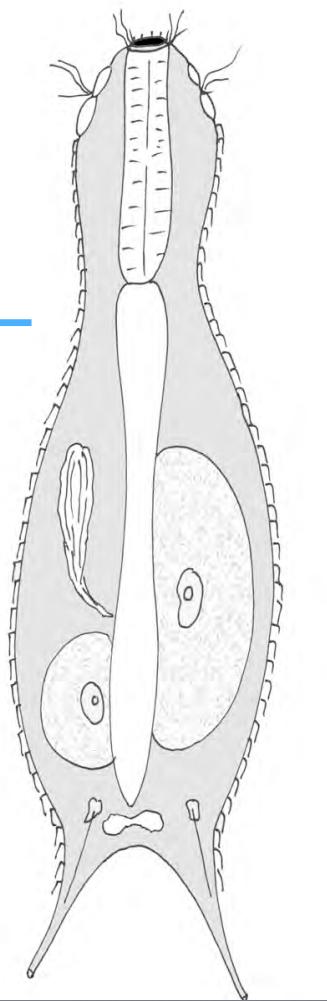


# How to recognize a gastrotrich



## Head or Pharyngeal Region

Terminal or subterminal mouth\*  
Straight pharynx\*



## Intestinal or midgut region

Straight gut  
Anus (peek a boo)  
Hermaphroditic reproductive organs  
Adhesive tubes  
Epidermal glands

## Post-anal region (adhesive tubes)

# How to recognize a gastrotrich

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## 1. Locomotion – ciliary gliders

- Generally slow moving (but not sluggish)



# How to recognize a gastrotrich

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2. Size - Most species < 1 mm long (so always smaller than a sand grain)



# How to recognize a gastrotrich

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2. Size – A few species can be 2-3 mm long



# How to recognize a gastrotrich

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3. Opacity – dependent on the structure of their cuticle  
Translucent (smooth cuticle) with a stereomicroscope

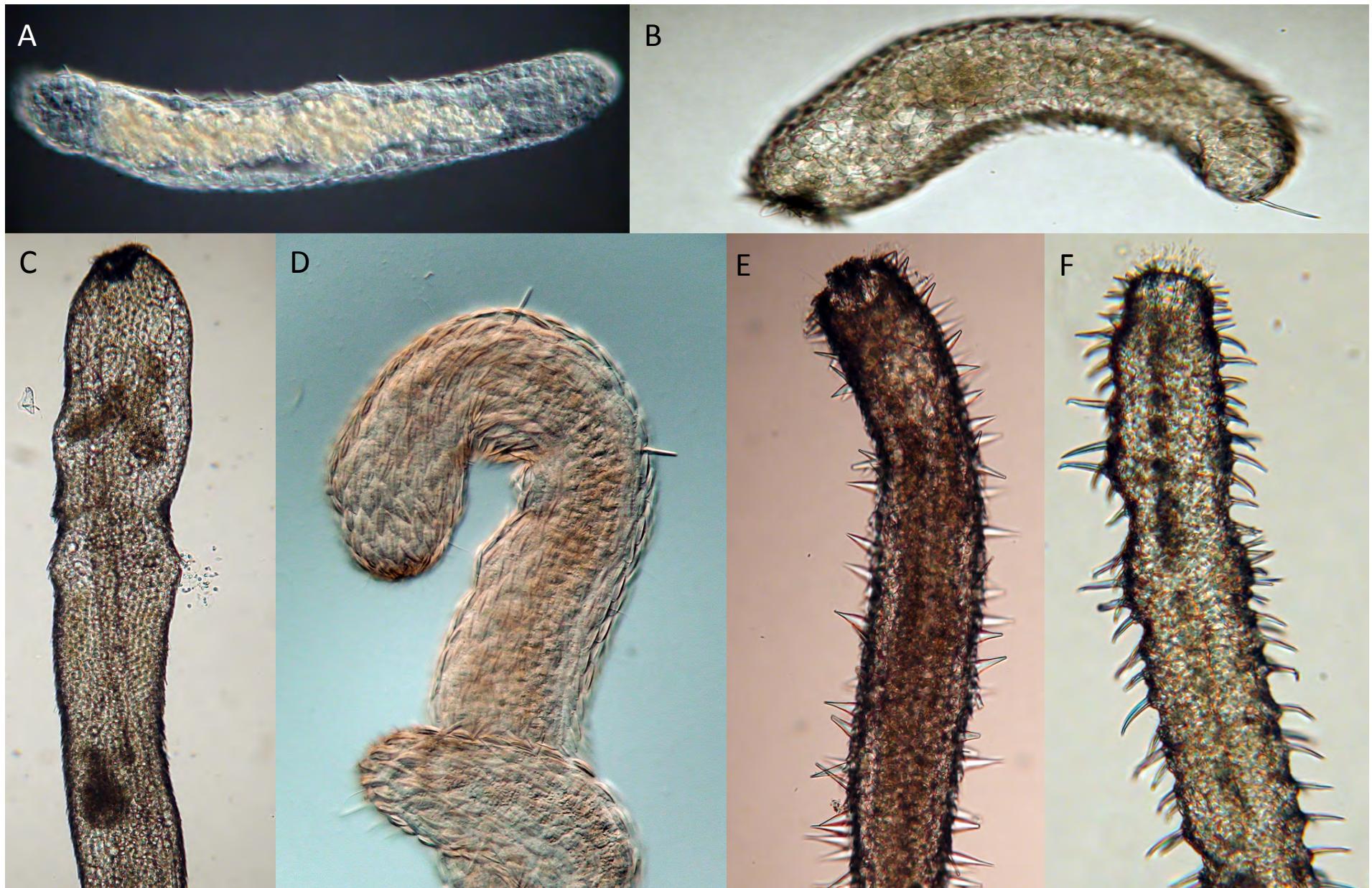


# How to recognize a gastrotrich

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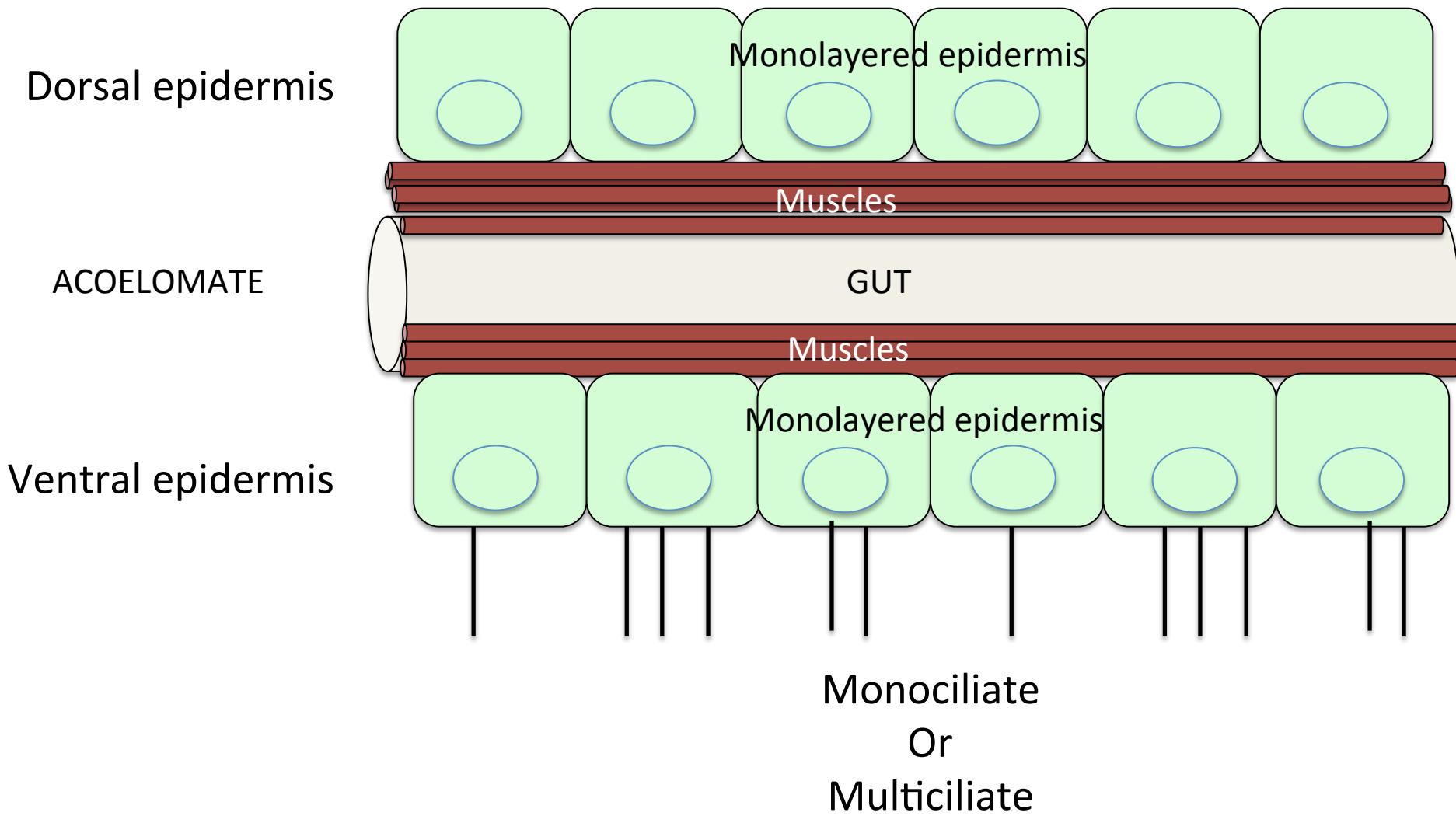
3. Opacity – dependent on the structure of their cuticle  
Opaque due to a structured (ornamented) cuticle



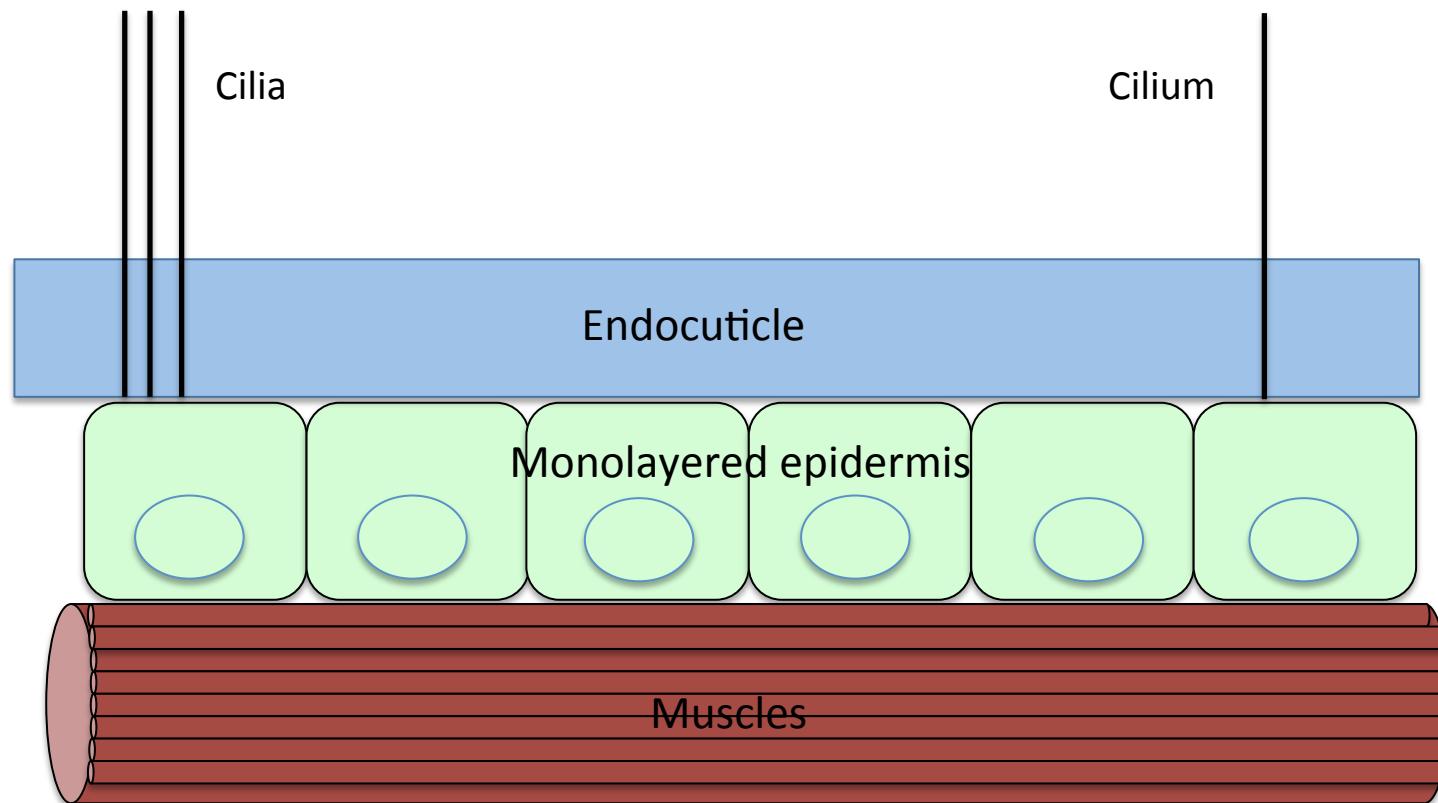


**Mollusca: Aplacophora: Caudofoveata (B, C, E)**  
**(ask Dr. Kevin Kocot)**

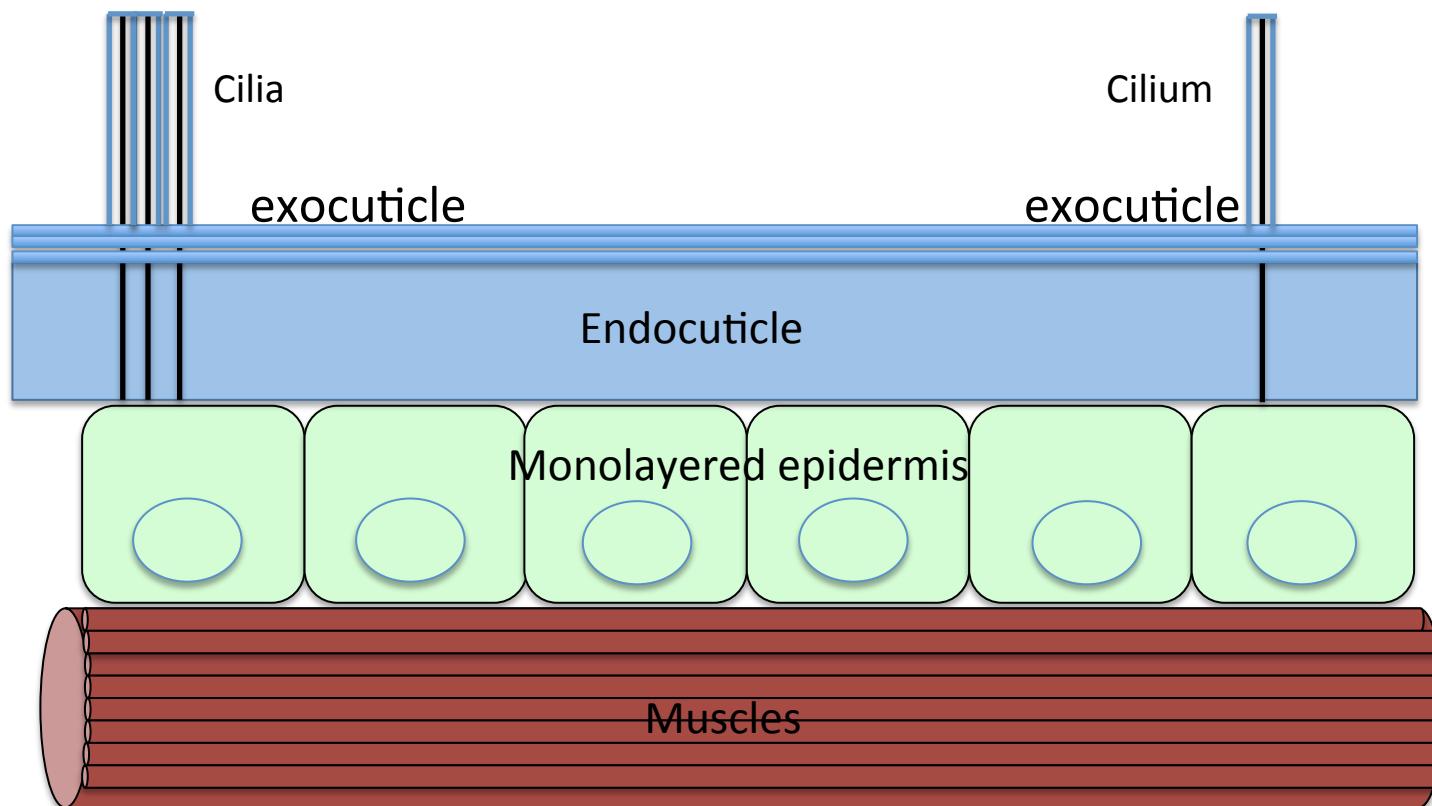
# Structure of the Gastrotrich Body Wall



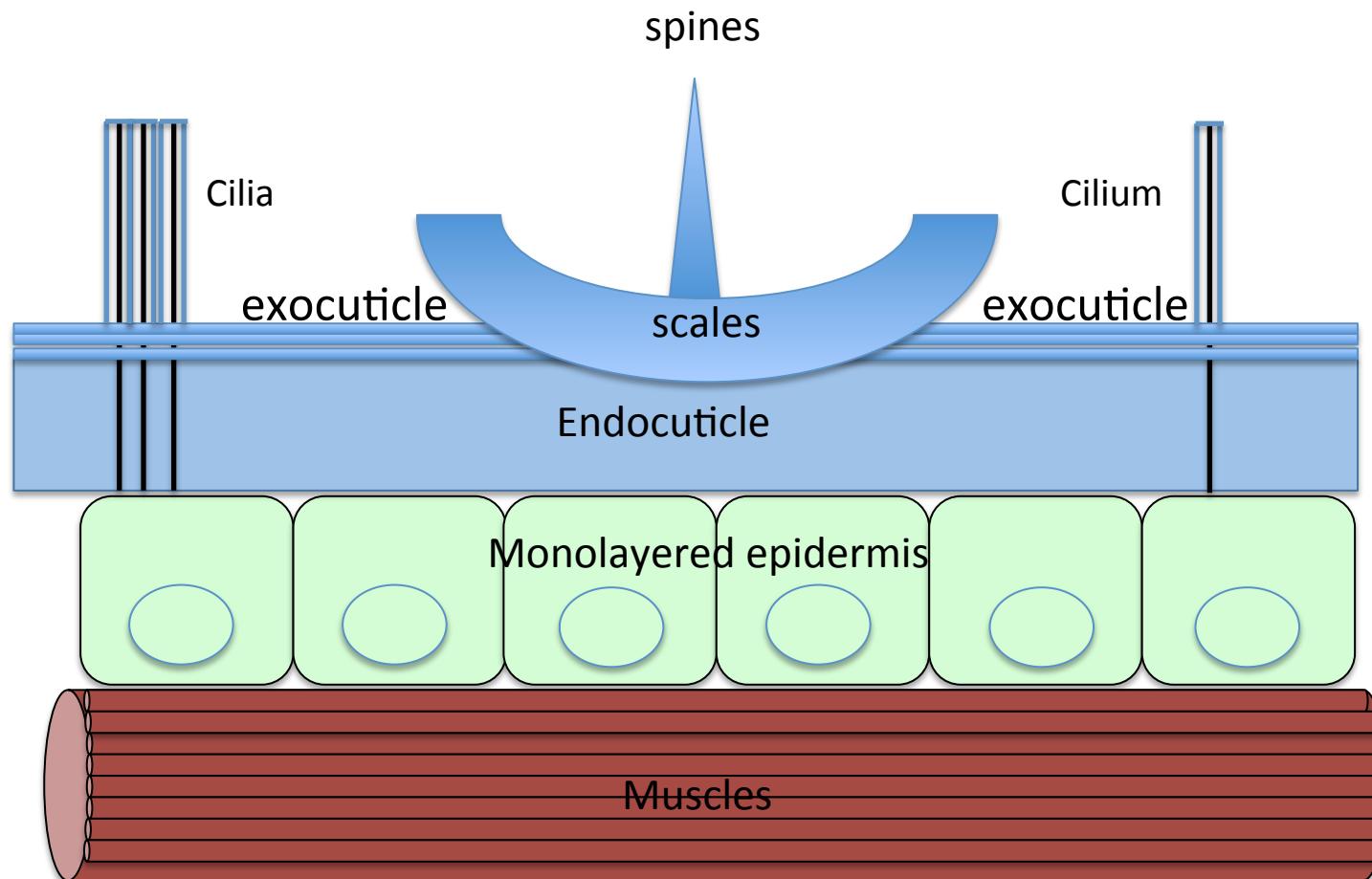
# Structure of the Gastrotrich Body Wall



# Structure of the Gastrotrich Body Wall



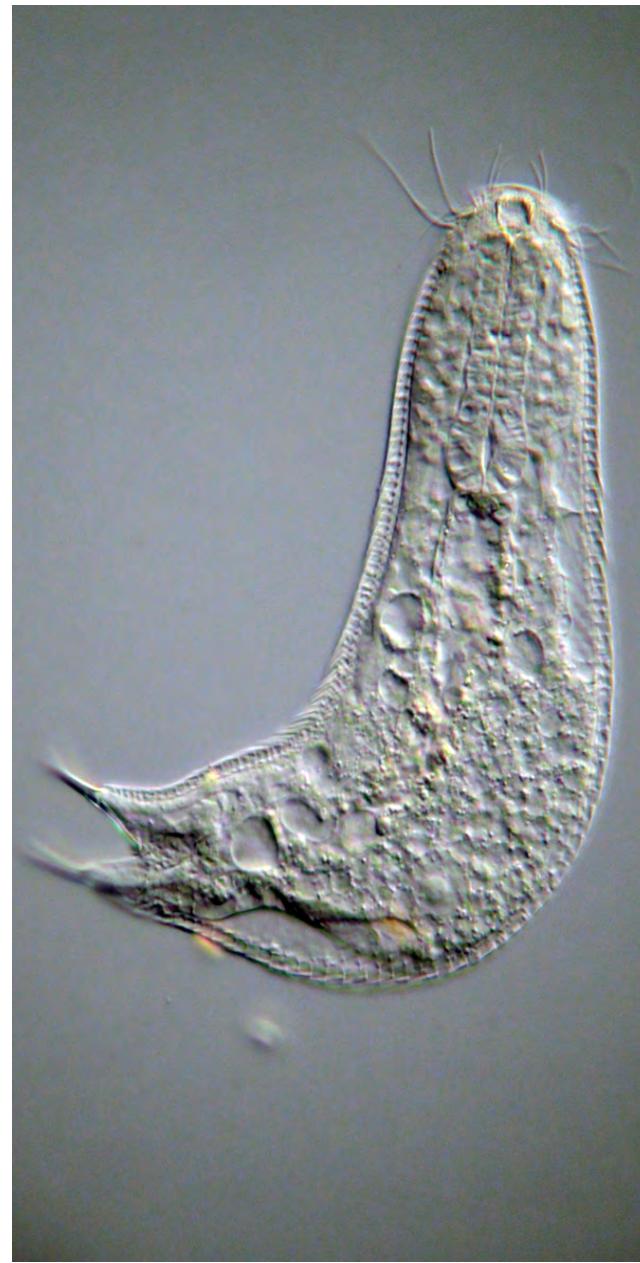
# Structure of the Gastrotrich Body Wall



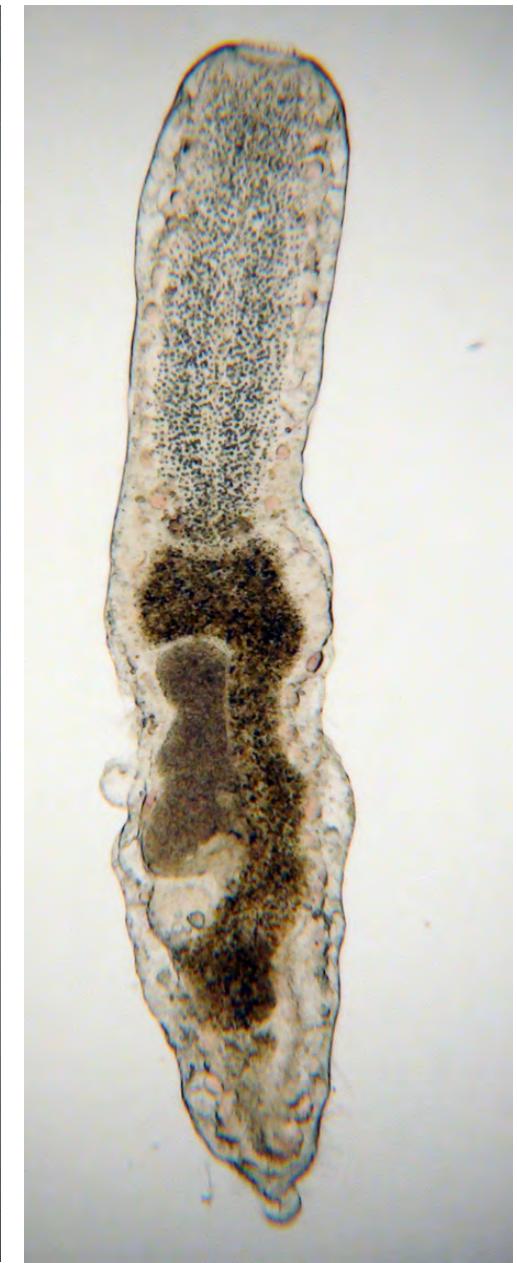
*Chaetonotus* – spined scales



*Aspidiophorus* – tiny scales



*Macrodasys*  
smooth cuticle

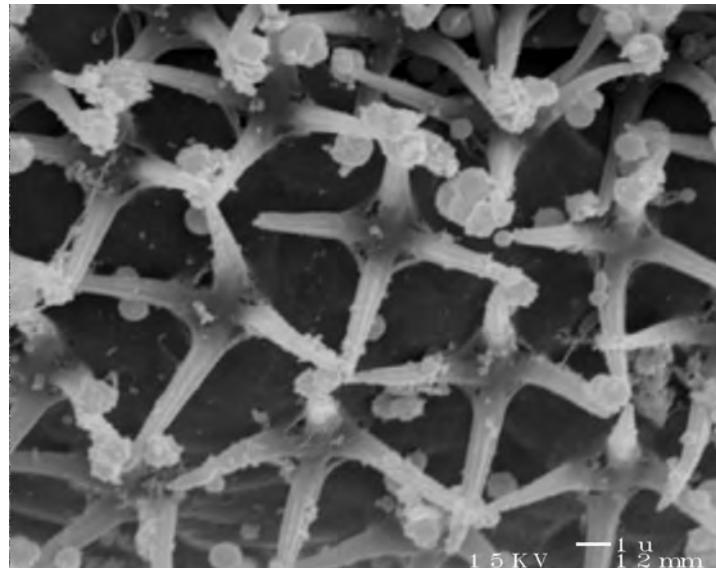


# Scales and Spines

*Thaumastoderma*



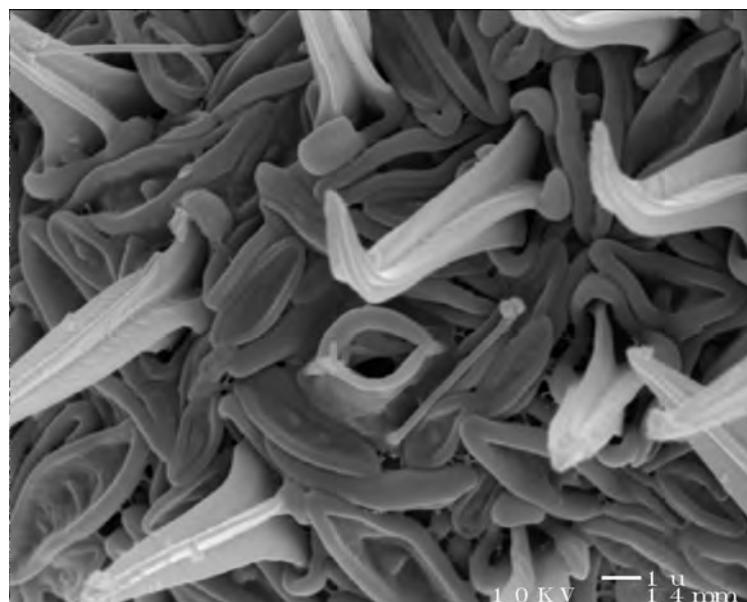
Tetrancres – 4-pronged spines



*Acanthodasys*



Uniancres – single spines



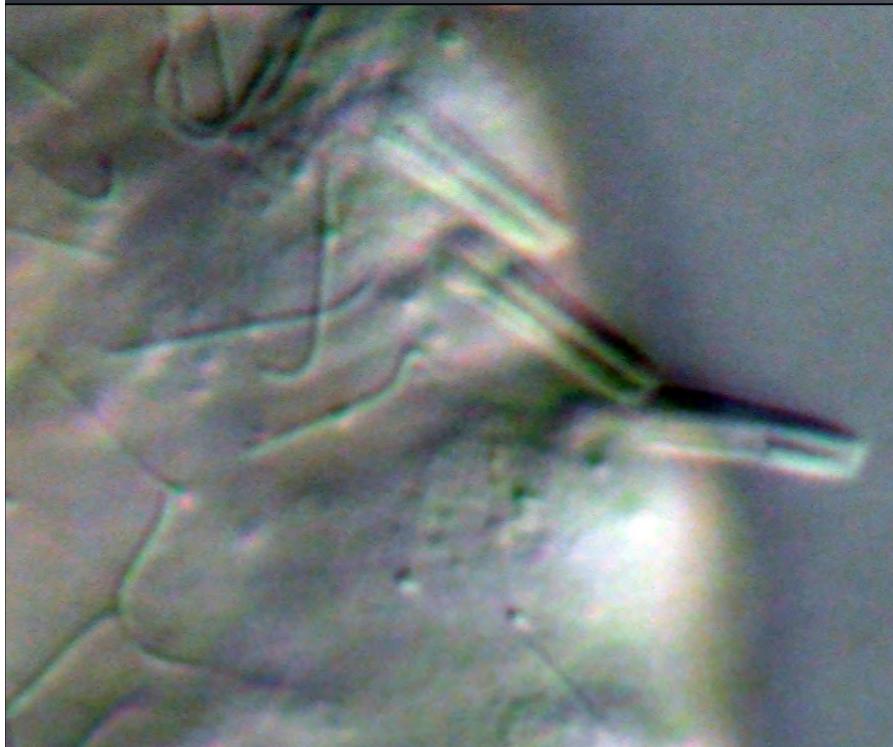
# How to recognize a gastrotrich

4. Adhesive tubes – not always easy to see with a stereo-microscope

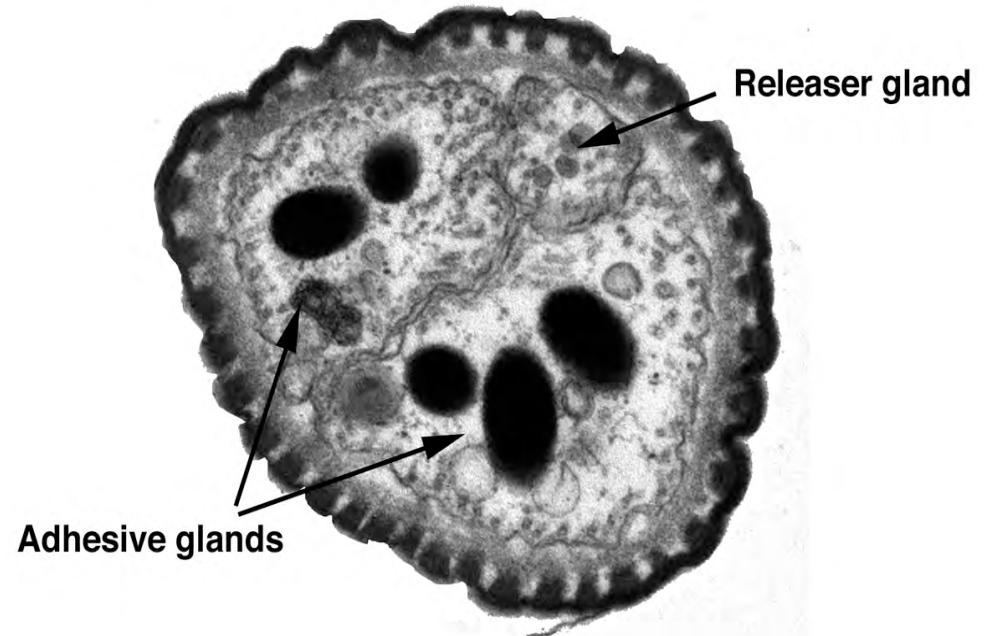


# How to recognize a gastrotrich

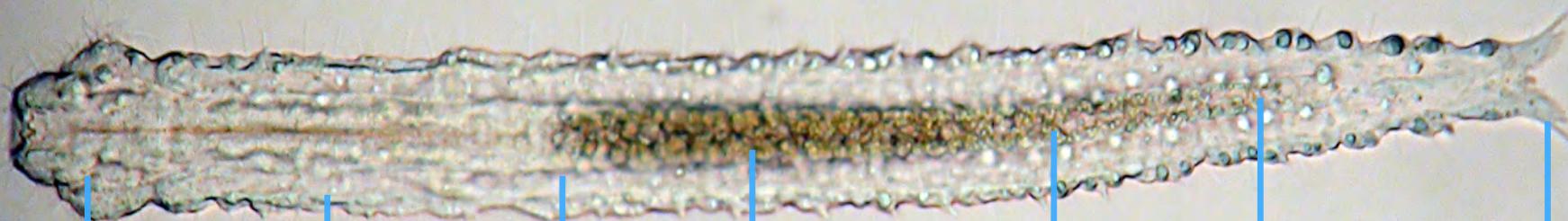
4. Adhesive tubes – not always easy to see with a stereo-microscope



TEM section through an adhesive tube



**ORDER MACRODASYIDA**



Anterior

Lateral

Ventrolateral

Ventral

Dorsolateral

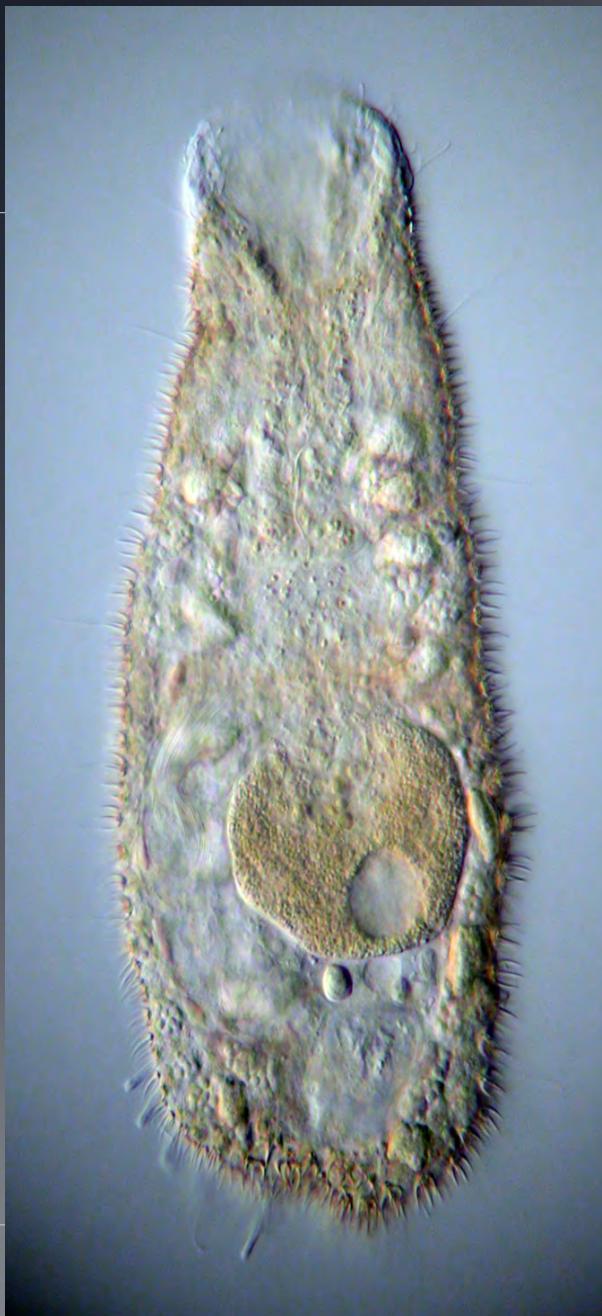
Dorsal

Posterior

**ORDER CHAETONOTIDA**



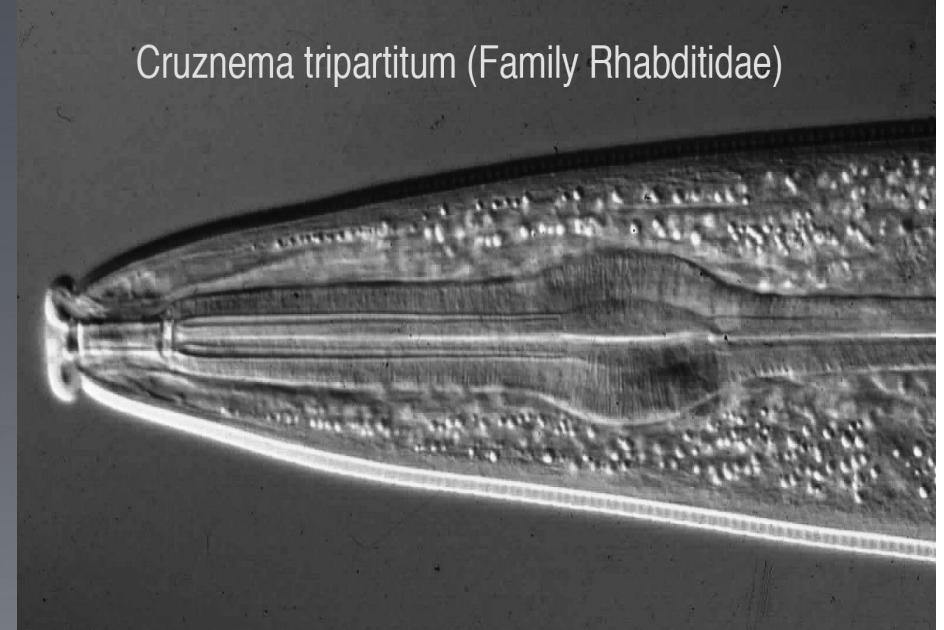
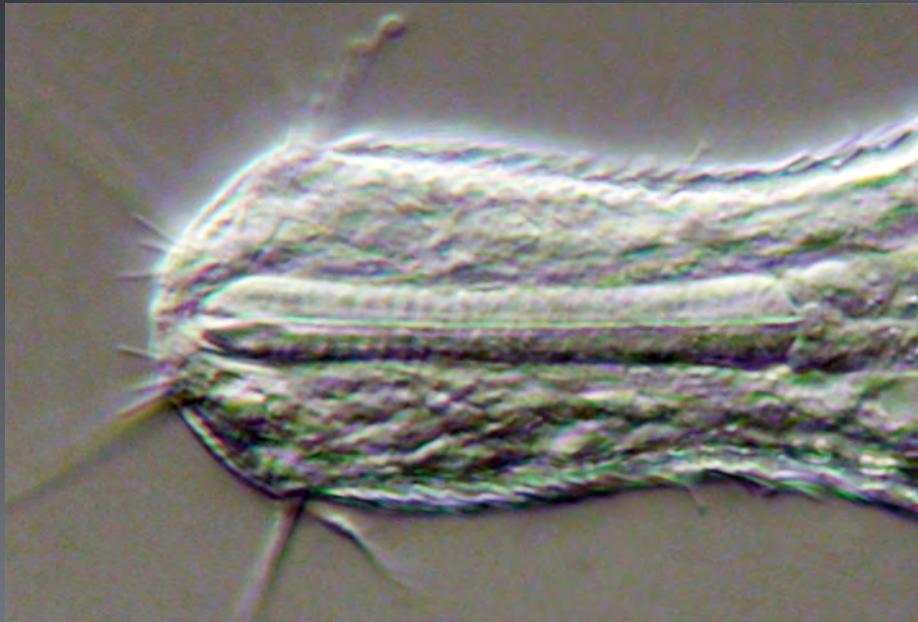
## Ventral Adhesive Tubes



# How to recognize a gastrotrich

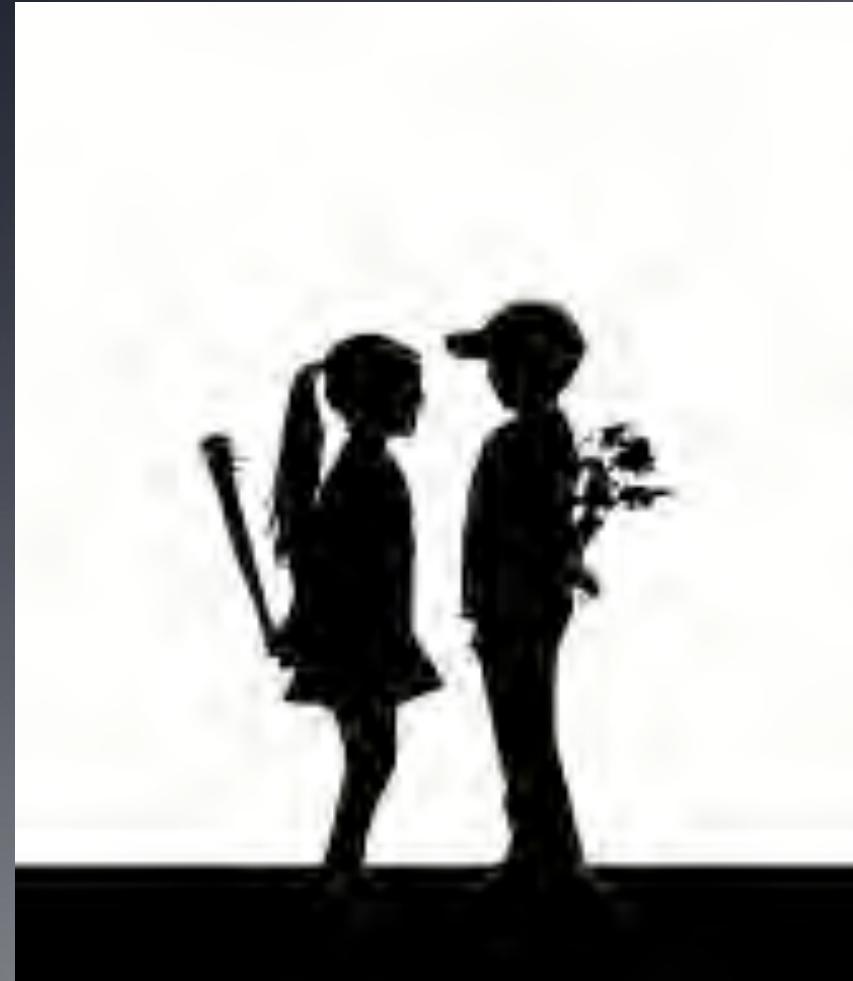
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5. Straight pharynx (positionally and structurally similar to nematodes) – Both myoepithelial with identical innervation



# Sexuality & the Reproductive System

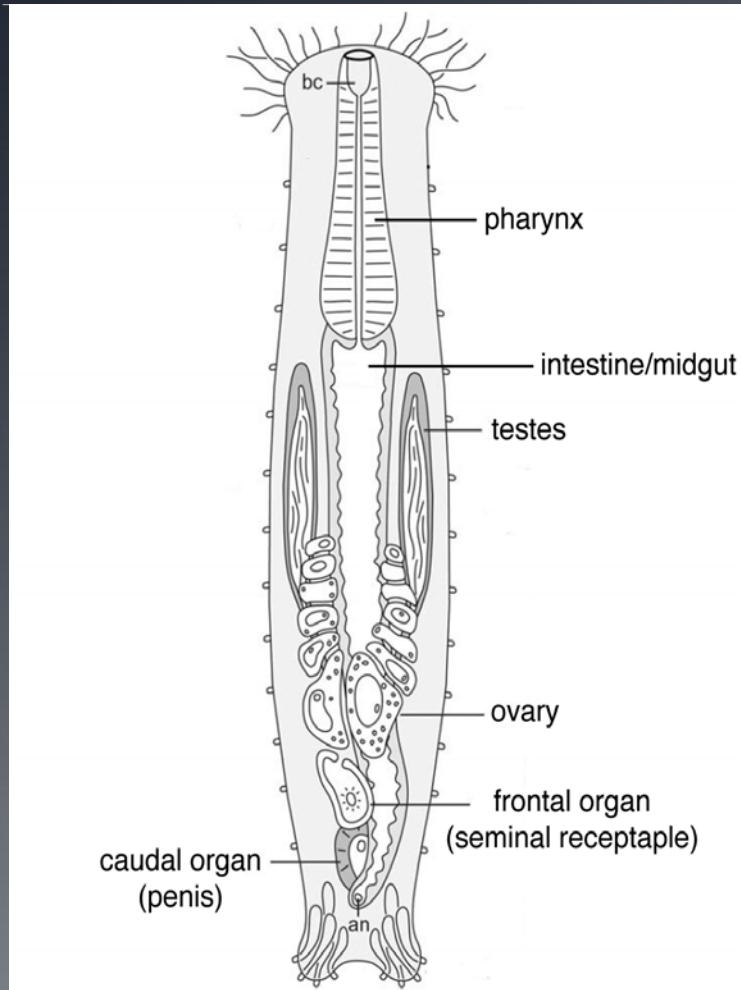
> 99% of all species are hermaphrodites



## Three Categories:

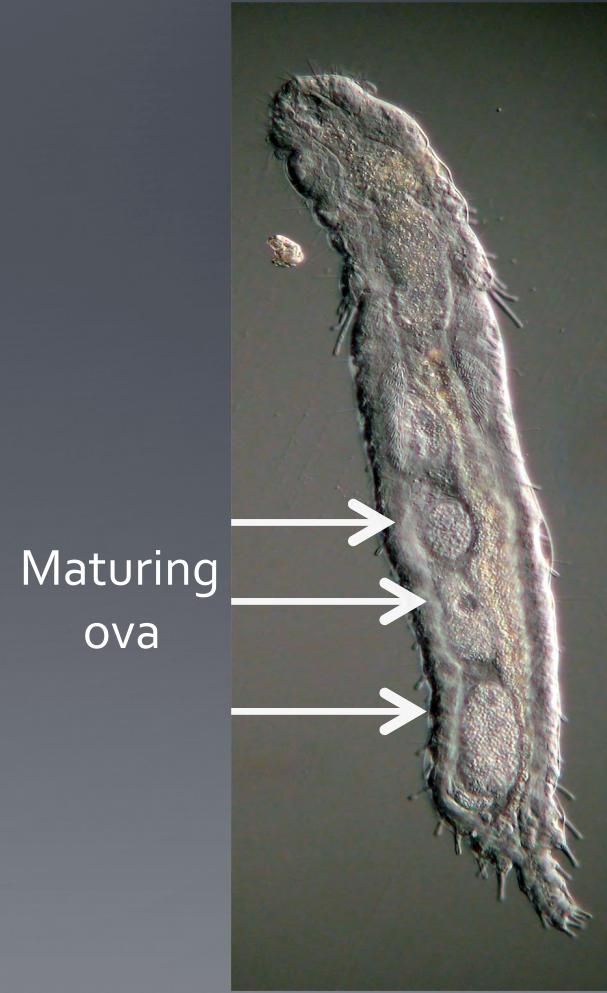
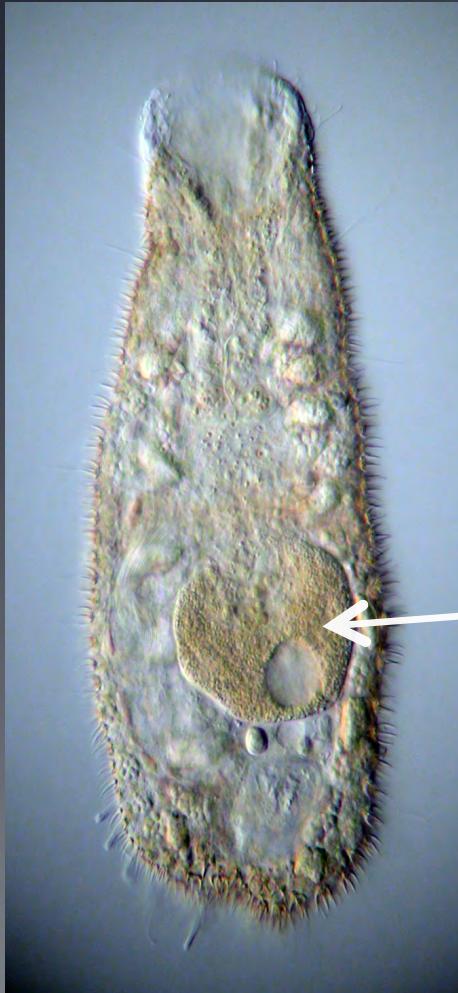
- 1) Simultaneous hermaphrodites
- 2) Biphasic hermaphrodites
- 3) Asexual species (<1%)

# Simultaneous Hermaphroditism



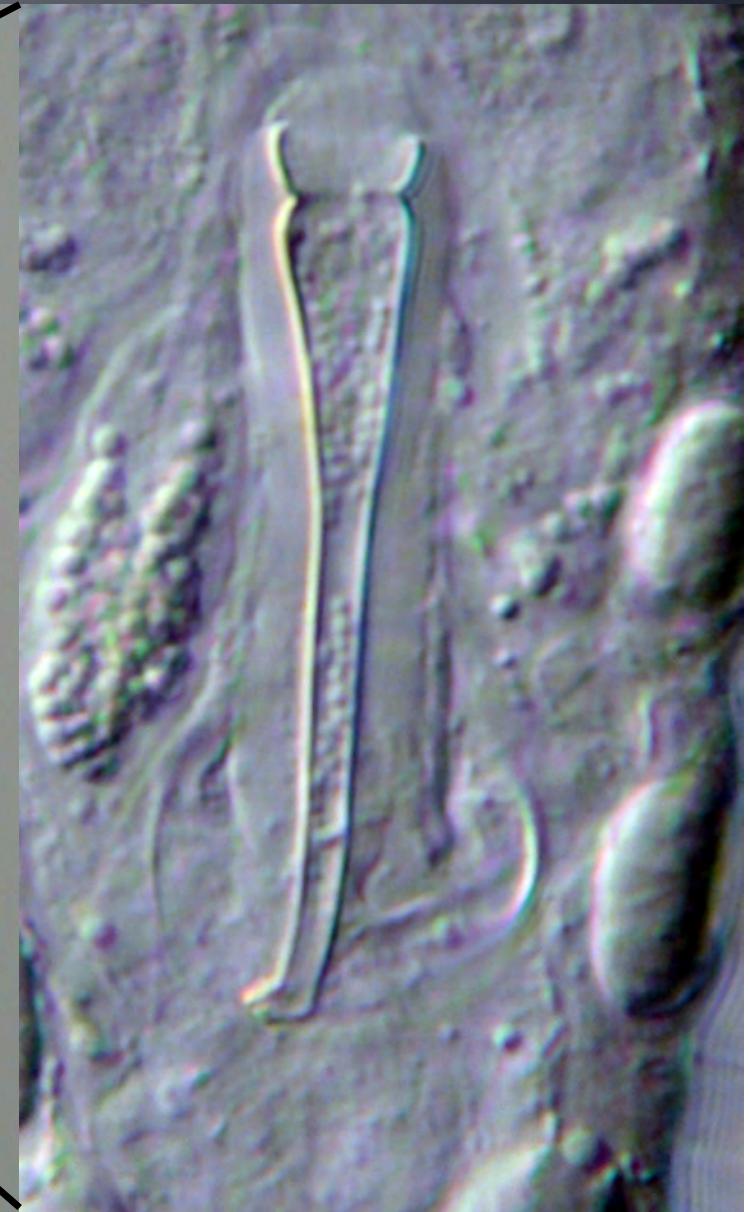
- Paired testis (some only have one)
- Paired ovaries (some only one)
- Copulatory organs (penis/stylet) and some don't have any
- Bursa organ (sperm storage)

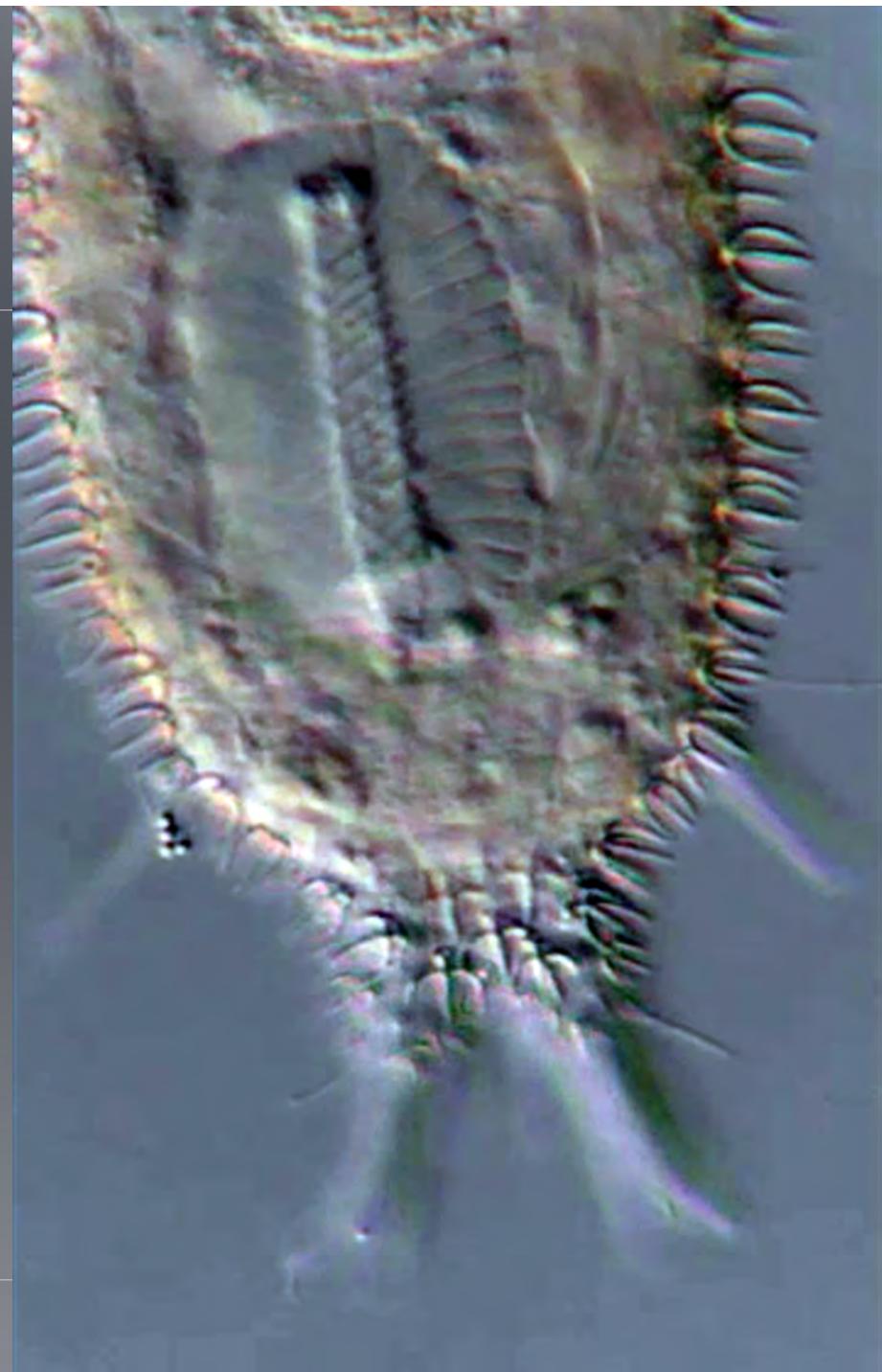
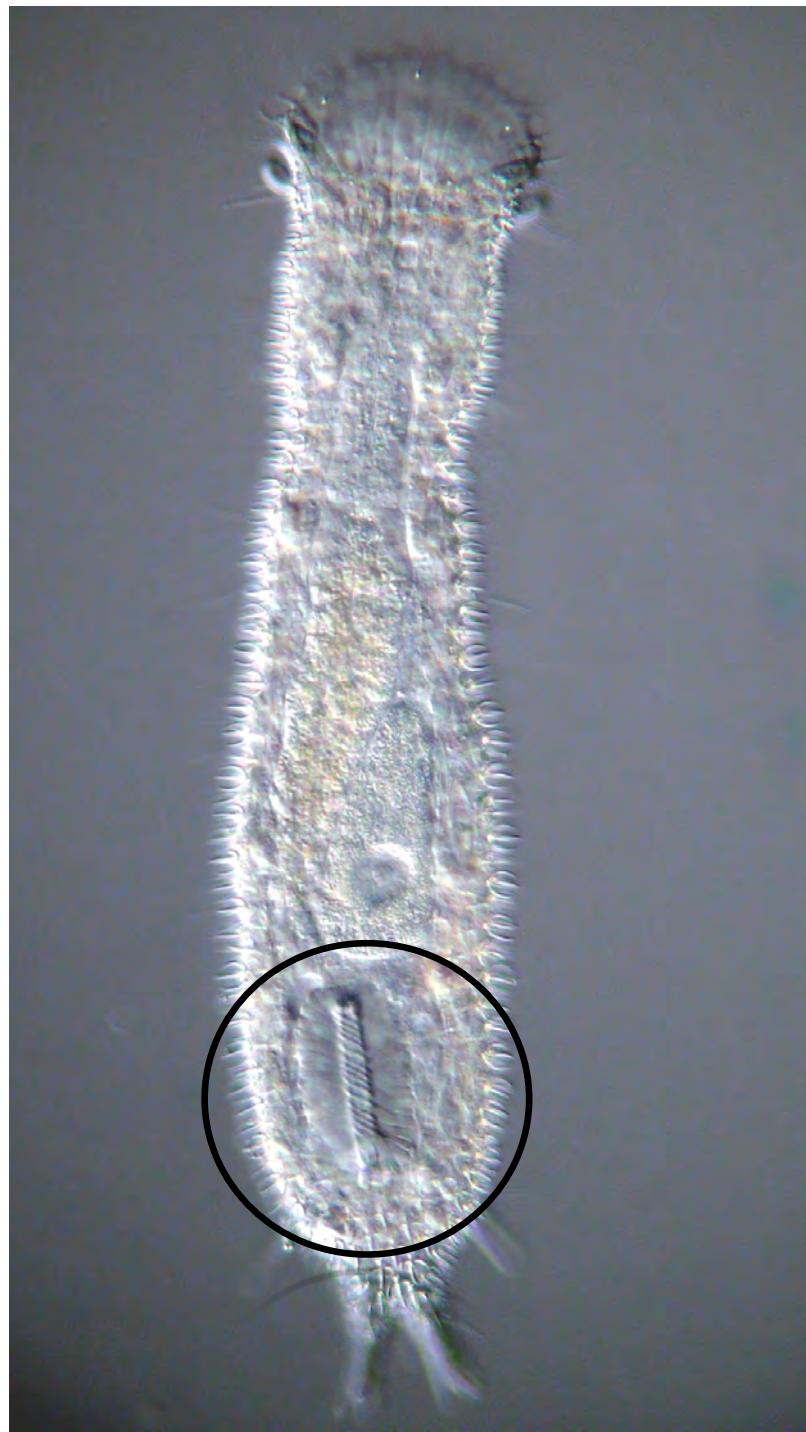
# Eggs and ova





## COPULATORY STYLETS





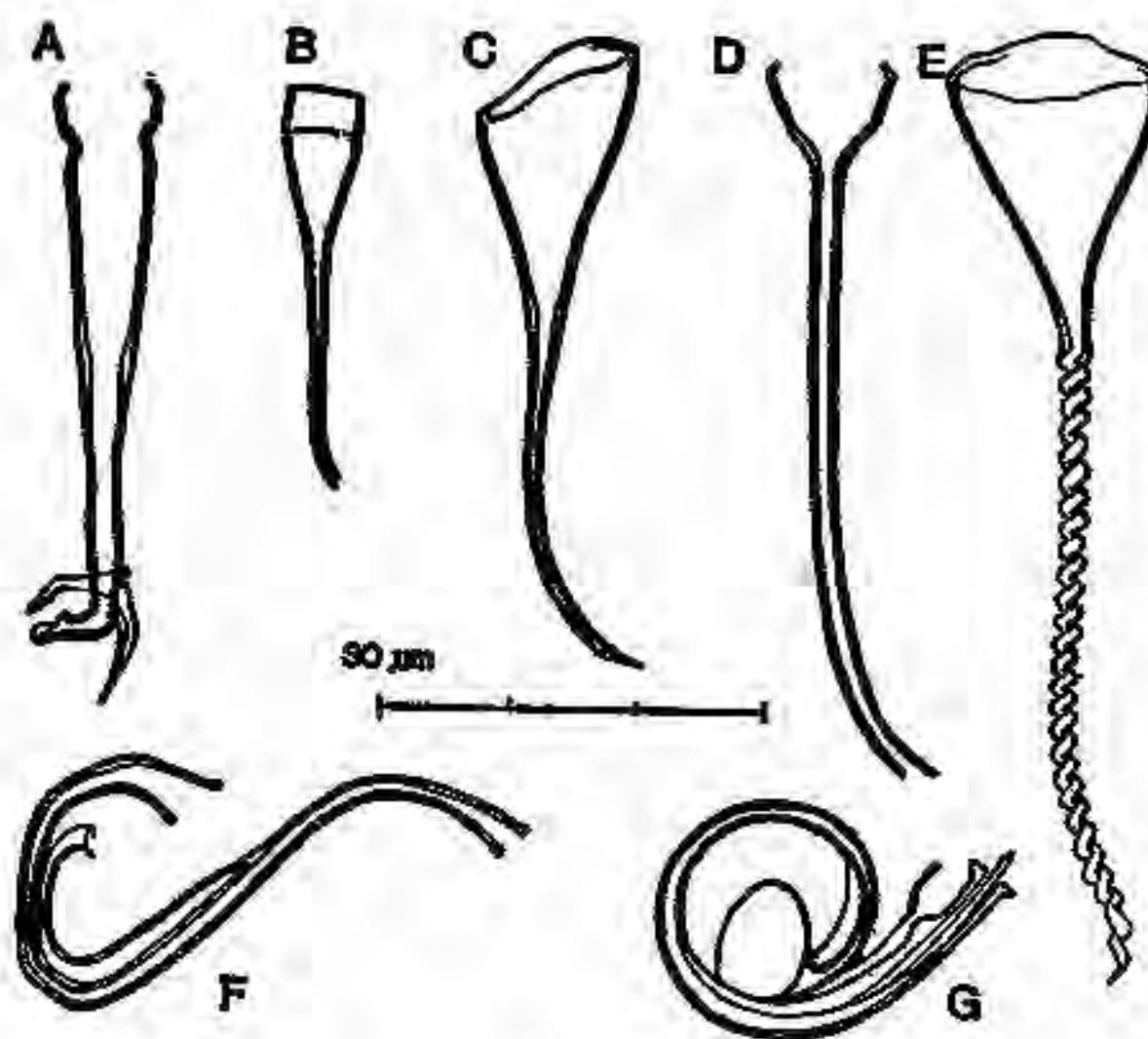
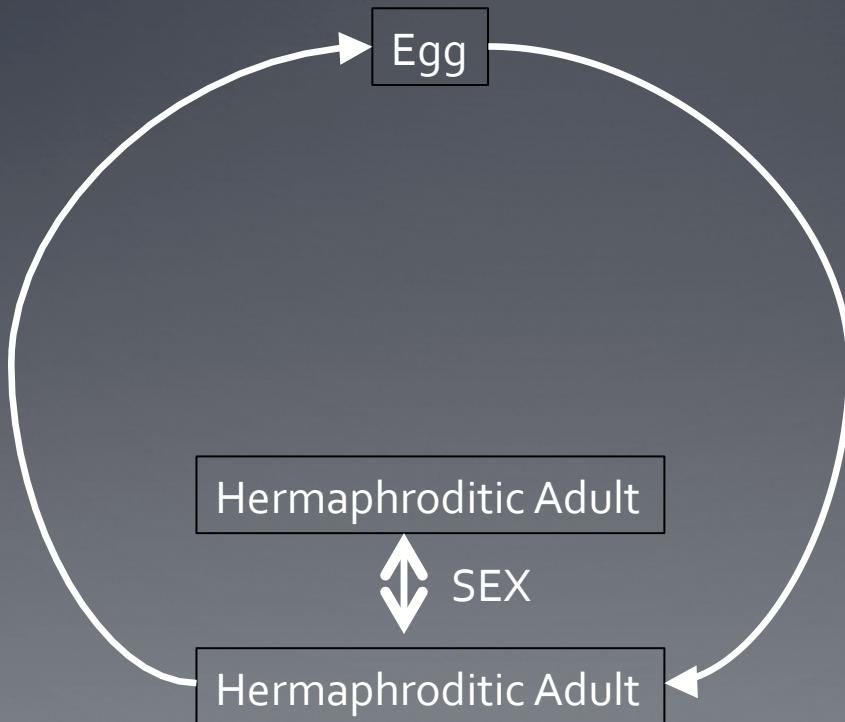


FIG. 5  
Cuticular stylets of the genus *Urodasys*

A : *U. nodostylis* ; B : *U. remostylis* ; C : *U. cornastylis* ; D : *U. calicostylis* ;  
E : *U. spirostylis* ; F : *U. sp.* I ; G : *U. sp.* II.

# Simultaneous Hermaphroditism

All engage in mutual cross fertilization followed by direct development



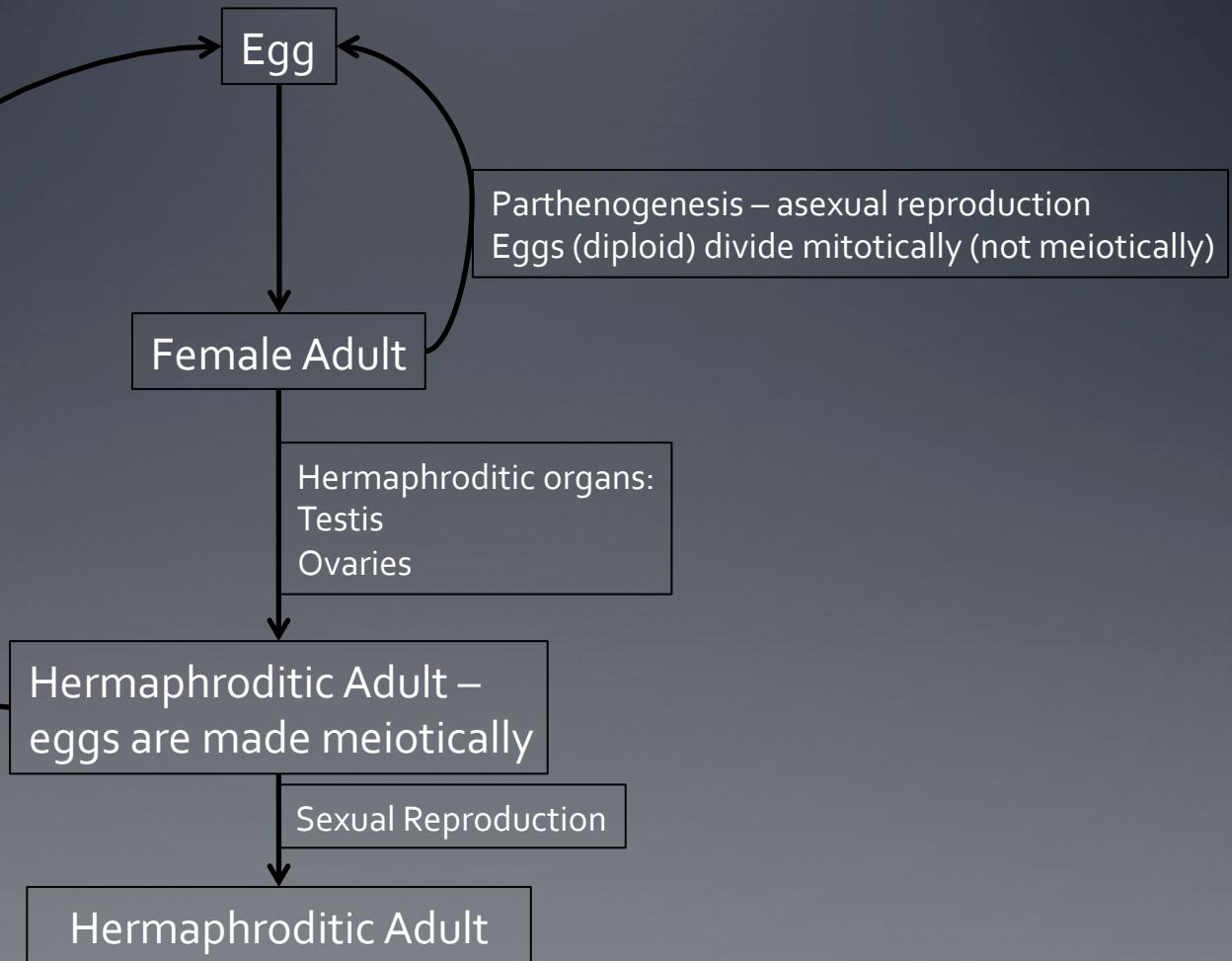
# 2<sup>nd</sup> Category of Gastrotrich hermaphroditism - Biphasic

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# Biphasic Hermaphroditism

All FW species &  
many marine  
species

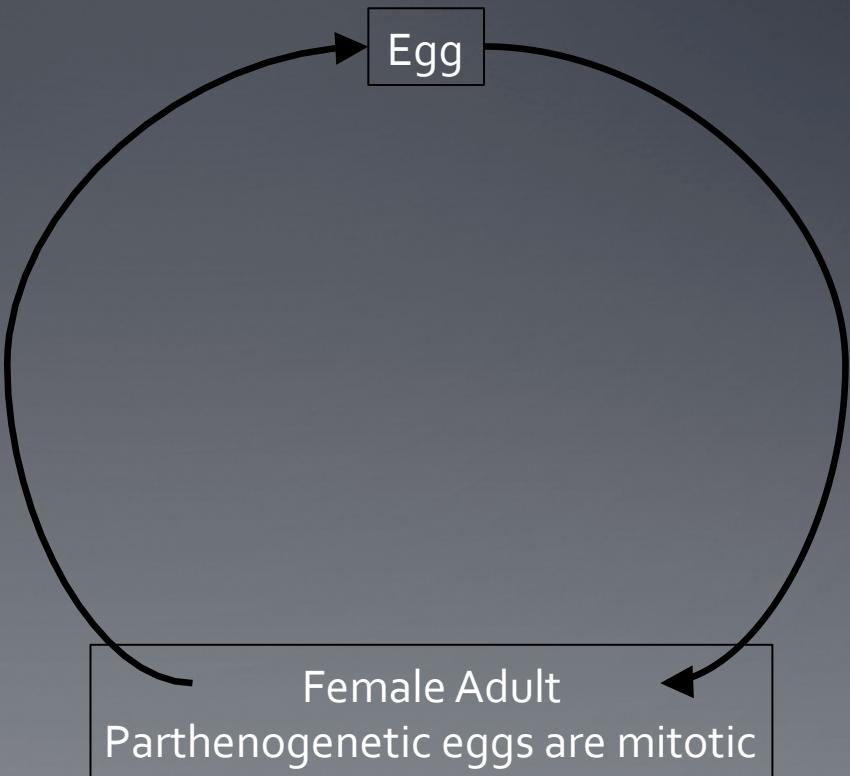


# 3<sup>rd</sup> Category of Gastrotrich Sex

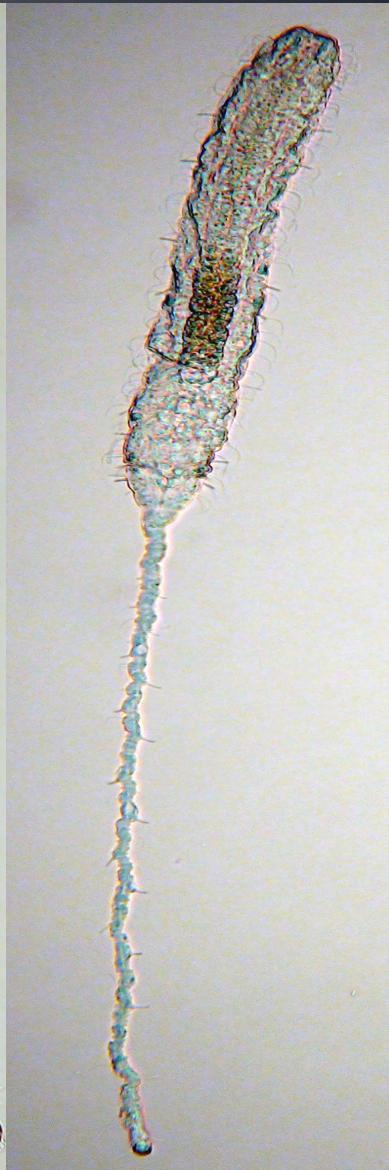
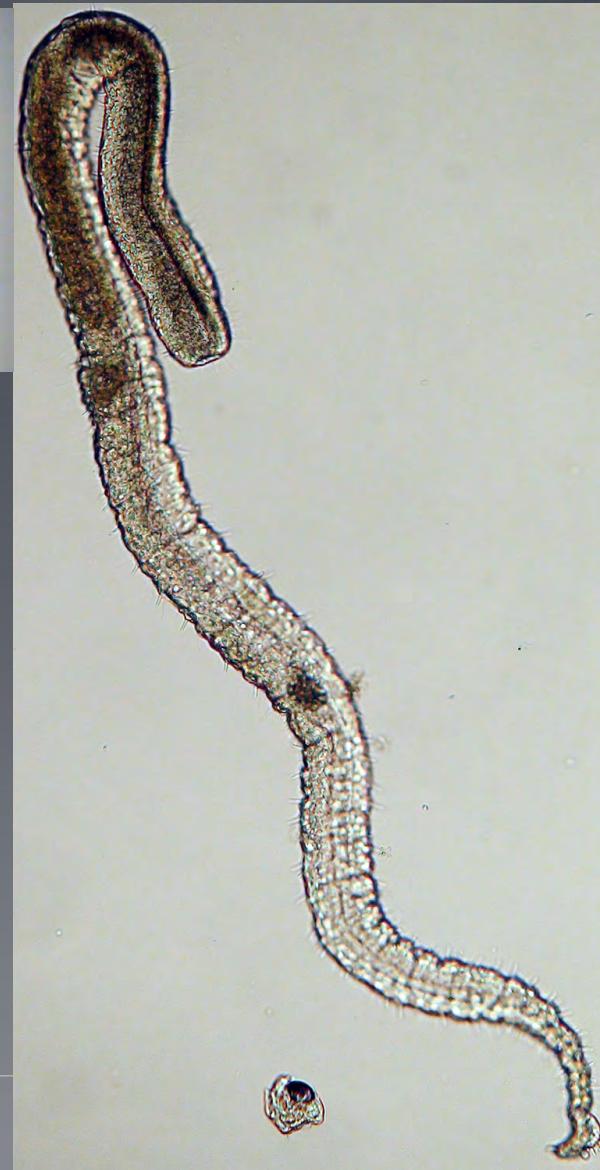


## Asexual Reproduction

Parthenogenesis – animals produce eggs that are clones of the mother



# Classification



# Once you find a gastrotrich...

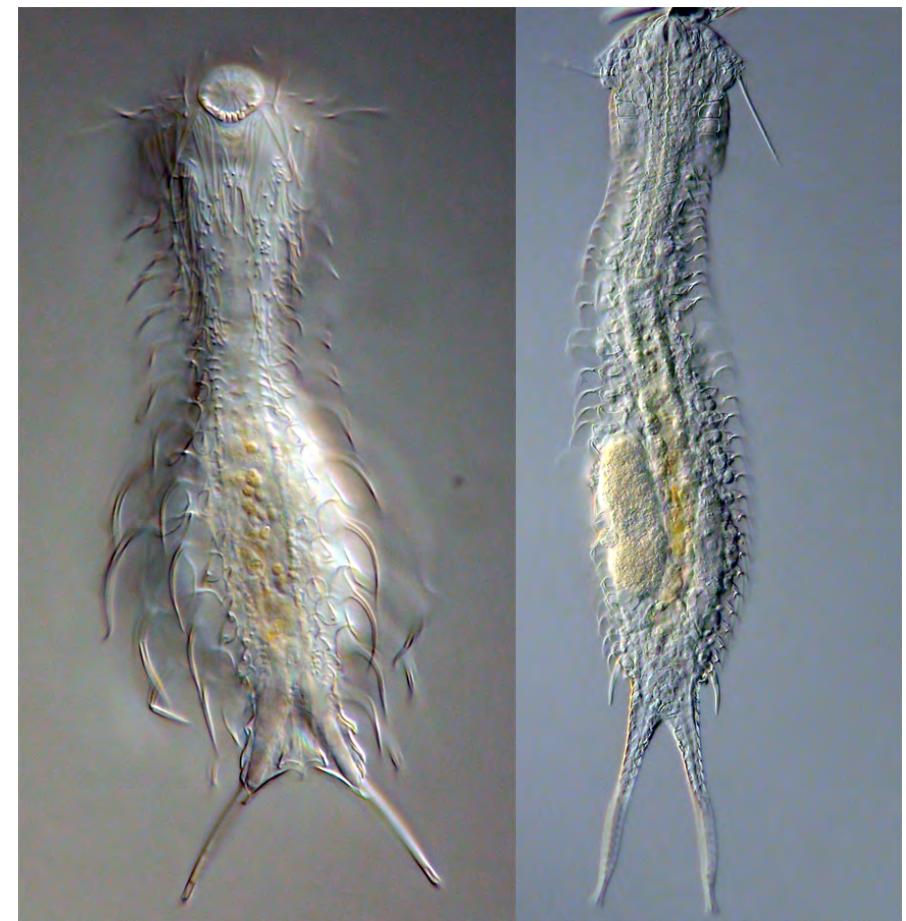
## ORDER MACRODASYIDA

NOT A BOWLING PIN



## ORDER CHAETONOTIDA

BOWLING PIN (2 posterior tubes)



## An overview and a dichotomous key to genera of the phylum Gastrotricha

M. Antonio Todaro\* and William D. Hummon\*\*

### Abstract

Gastrotricha are microscopic (0.06-3.0 mm in body length) free-living, acoelomate, aquatic worms, characterised by a meiobenthic life style. In marine habitats they are mainly interstitial, whereas in fresh waters they are ubiquitous as a component of periphyton and benthos and to a more limited extend also of the plankton. The phylum is cosmopolitan with about 700 described species grouped into two orders: Macrodasyida, with some 250 strap-shaped species, all but two of which are marine or estuarine, and Chaetonotida with some 450 tenpin-shaped species, two thirds of which are freshwater. Macrodasyida include 7 families and 32 genera, whereas Chaetonotida counts 8 families and 30 genera. This key includes several recently described taxa, namely Xenodasyidae, Muselliferidae, *Chordodasiopsis* and *Diuronotus*.

Keywords: meiofauna, invertebrates, benthos, teaching, taxonomy

### Introduction

Gastrotricha are microscopic (0.06-3.0 mm in body length) free-living, acoelomate, aquatic worms, characterised by a meiobenthic life style. In marine habitats they are mainly interstitial, whereas in fresh waters they are ubiquitous as a component of periphyton and benthos and to a more limited extend also of the plankton. In marine sediments, gastrotrich density may reach 364 individuals/10 cm<sup>2</sup>; typically they rank third in abundance following the Nematoda and the harpacticoid Copepoda, although in several instances they have been found to be first or the second most abundant meiofaunal taxon (Coull 1985, Todaro et al. 1995, Hochberg 1999).

In freshwater ecosystems population density may reach 158 ind./10 cm<sup>2</sup> making the taxon rank among the top 5 most abundant groups. In aquatic environments the ecological role of the gastrotrichs is realised within the microphagous, detritivorous, benthic community. Like free-living nematodes, gastrotrichs swallow their food, which is made up of microalgae, bacteria and small protozoans, by means of the powerful sucking action of the triradiate muscular pharynx, and in turn they are preyed upon by turbellarians and small macrofauna.

The phylum is cosmopolitan with about 700 described species grouped into two orders: Macrodasyida, with some 250 strap-shaped species, all but two of which are marine or estuarine, and

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# Global Database of Marine Gastrotricha

<http://hummon-nas.biosci.ohiou.edu/>

## Gastrotricha Global Database

Name	Last modified	Size	Description
<a href="#">WMV or MPG1/</a>	15-Oct-2010 12:30	-	
<a href="#">WDH pdf Literature/</a>	11-Dec-2009 21:08	-	
<a href="#">n.spp. in review/</a>	03-Dec-2010 14:13	-	
<a href="#">MPEG-2 Video/</a>	15-Oct-2010 12:40	-	
<a href="#">2010 Global DB MarGast/</a>	03-Feb-2010 11:13	-	
<a href="#">12-22-08 - Introduction.pdf</a>	22-Dec-2008 14:48	90K	
<a href="#">12-22-08 - Introduction.doc</a>	22-Dec-2008 14:49	68K	
<a href="#">12-20-08 Video Sequences.pdf</a>	22-Dec-2008 14:51	8.8K	
<a href="#">12-20-08 Video Sequences.doc</a>	20-Dec-2008 11:35	24K	

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SYSTEMATICS

Systematics by M.A.Todaro (2003; last update: December 2016)

Order **MACRODASYIDA** Remane, 1925 [Rao and Clausen, 1970] Pdf Word

- Family **CEPHALODASYIDAE** Hummon & Todaro, 2010 Pdf
  - Genus **Cephalodasys** Remane, 1926 Pdf
  - Genus **Dolichodasys** Gagne, 1977 Pdf
  - Genus **Mesodasys** Remane, 1951 Pdf
  - Genus **Paradasys** Remane, 1934 Pdf
  - Genus **Pleurodasys** Remane, 1927 Pdf
- Family **DACTYLOPODOLIDAE** Strand, 1929 Pdf
  - Genus **Dactylopodola** Strand, 1929 Pdf
  - Genus **Dendrodasys** Wilke, 1954 Pdf
  - Genus **Dendropodola** Hummon, Todaro & Tongiorgi, 1993 Pdf
- Family **HUMMONDASYIDAE** Todaro, Leasi & Hochberg, 2014 Pdf
  - Genus **Hummondasys** Todaro, Leasi & Hochberg, 2014 Pdf
- Family **LEPIDODASYIDAE** Remane, 1927 Pdf
  - Genus **Lepidodasys** Remane, 1926 Pdf
- Family **MACRODASYIDAE** Remane, 1924 Pdf
  - Genus **Macrodasys** Remane, 1924 Pdf
  - Genus **Thaidasys** Todaro, Dal Zotto & Leasi, 2015 Pdf
  - Genus **Urodasys** Remane, 1926 Pdf
- Family **PLANODASYIDAE** Rao & Clausen, 1970 Pdf
  - Genus **Crasiella** Clausen, 1968 Pdf

# Processing of gastrotrichs for archival and study

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1. Relaxation (7% magnesium chloride: 30-35 ppt) for 5-10 min.
  2. Photo & video documentation (whole animal, close-ups of the reproductive organs, EVERYTHING)
  3. Basic measurements (body length, width, pharynx, # adhesive tubes - anterior, lateral, ventrolateral, posterior series, size of reproductive organs)
-

# Processing of gastrotrichs for archival and study

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## Molecular Work:

- 95% etoh or RNA later (depending on intent)
- Generally process animals individually due to the possibility of “cryptic species”

## Morphology

- Confocal microscopy – 4% paraformaldehyde in 0.1M PBS buffer (can last several weeks if cool)
  - Electron microscopy – 2.5% glutaraldehyde in 0.1M cacodylate buffer
  - Museum archival – EM fixation and then epon resin on slide
-

I think that gastrotrichs are awesome

