

# The Phylum Nematoda: phylogeny, systematics, and taxonomy with an emphasis on marine nematodes

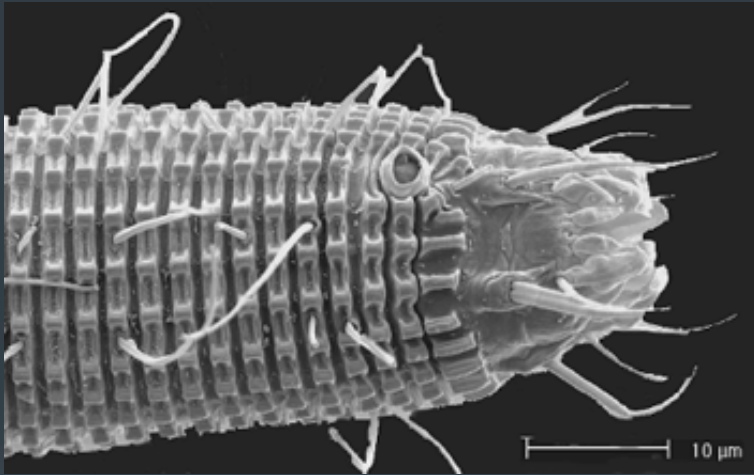


Photo: M. Mundo-Ocampo



Photo: T.J. Pereira

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# Outline

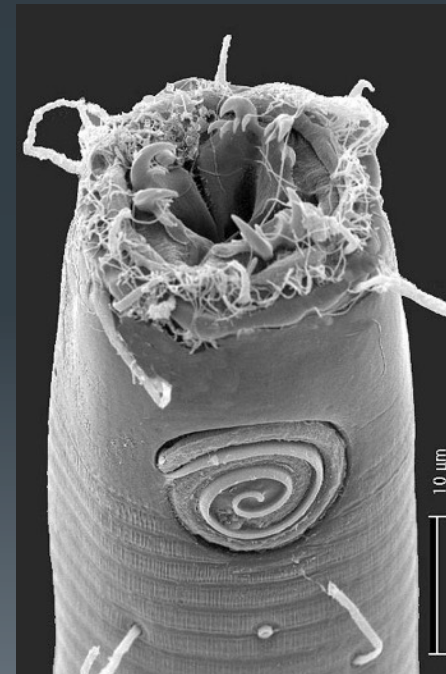
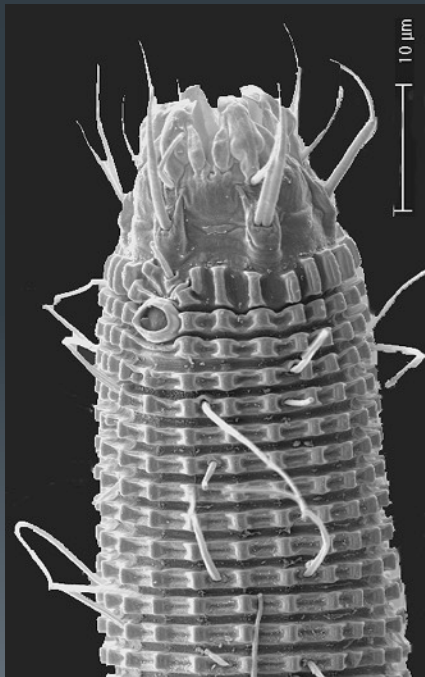
- Nematode diversity/Importance
- Advances on nematode phylogeny
- General nematode morphology
- The important groups of marine nematodes
- Preparing and identifying nematode specimens
- Sources for nematode identification

# Why do we study nematodes?



Abundance: found in all kinds of ecosystems (terrestrial, freshwater, and marine).

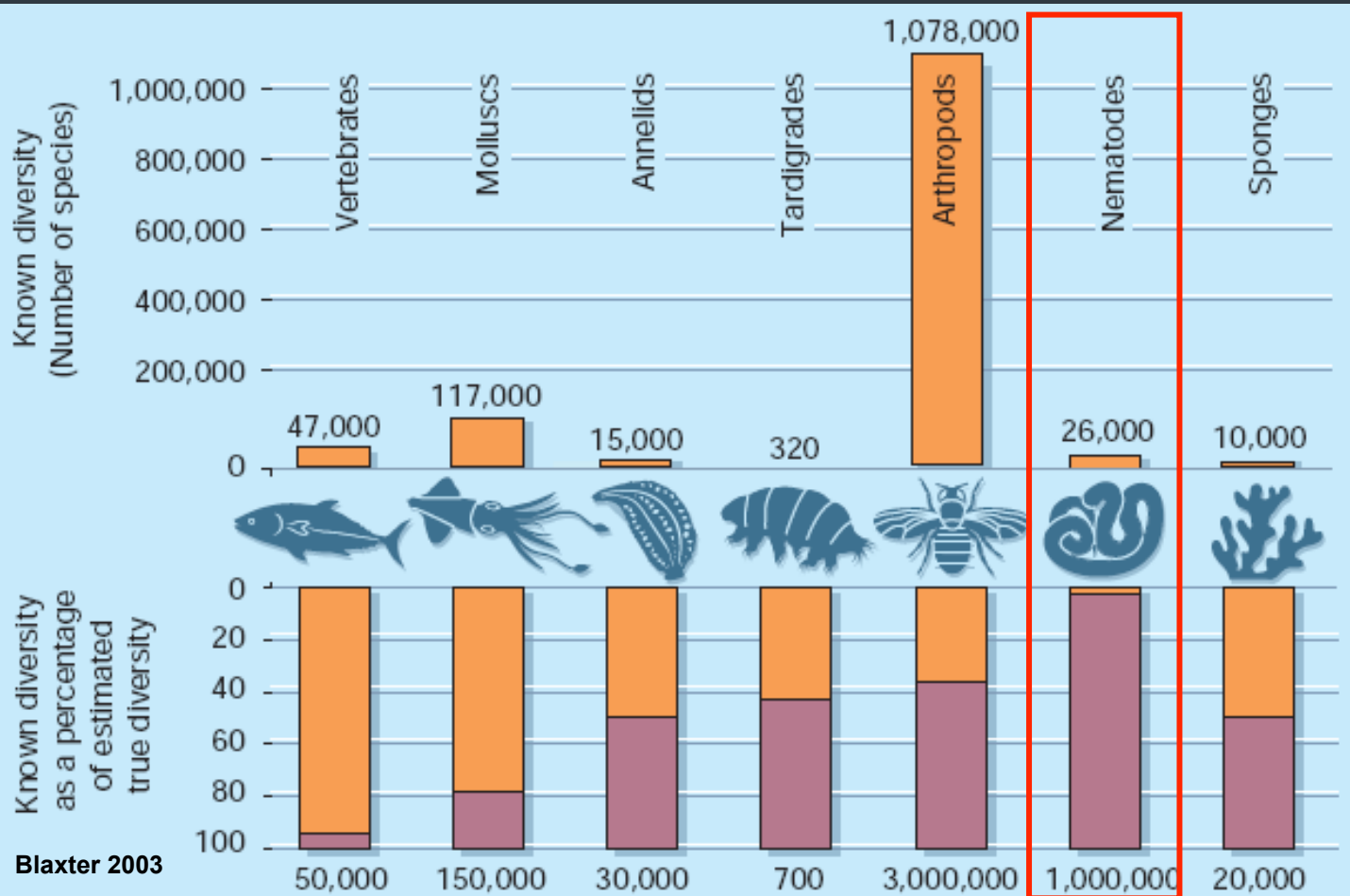
Diversity: millions species, different life-styles



Photos: Mundo-Ocampo

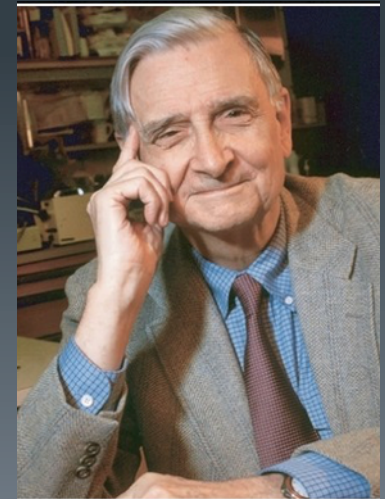
*“we do not look all the same”*

# How much do we know about it?

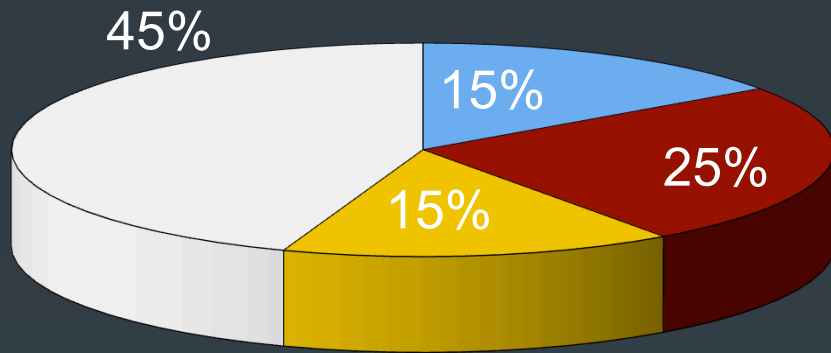


(Blaxter, 2016)  
- Deep-sea  
- Cryptic species

“Nematodes account for four of every five animals living on Earth, almost all of species unknown” (E. O. Wilson, 2003).



# Diversity among nematode groups

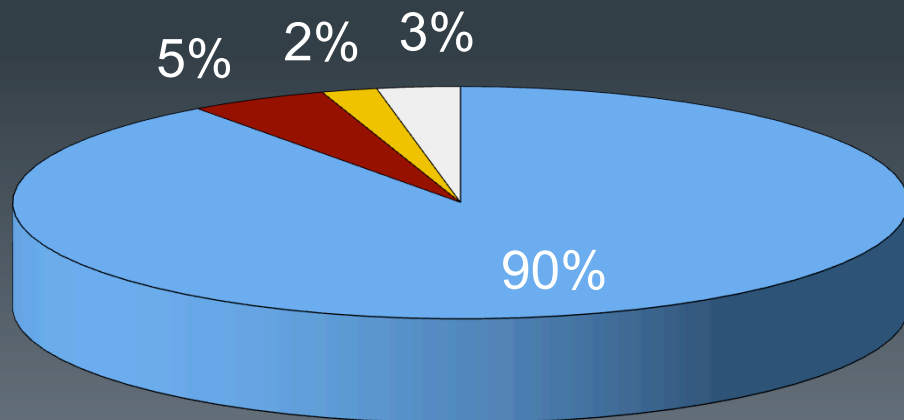


Hugot et al. 2001



Known species in the different groups

- Marine
- Terrestrial
- Plant Parasites
- Animal Parasites



Baldwin et al. 1997

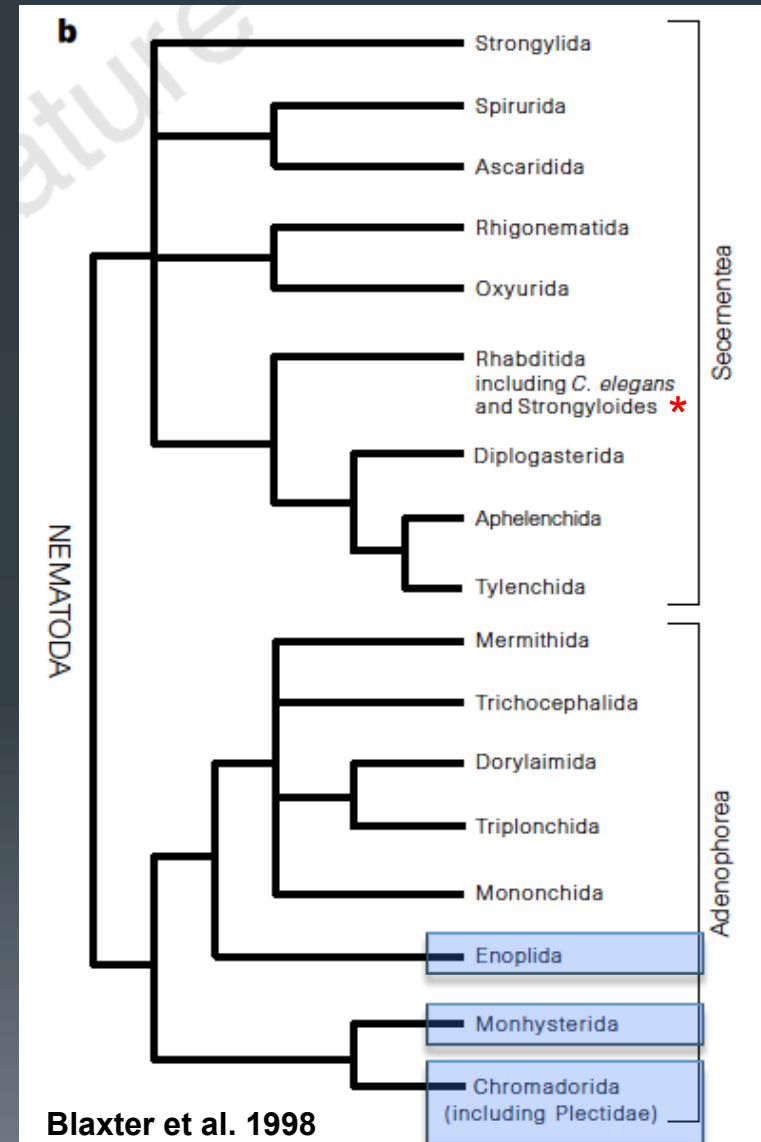


Estimated diversity in the different groups

# Classification (prior to molecular data)

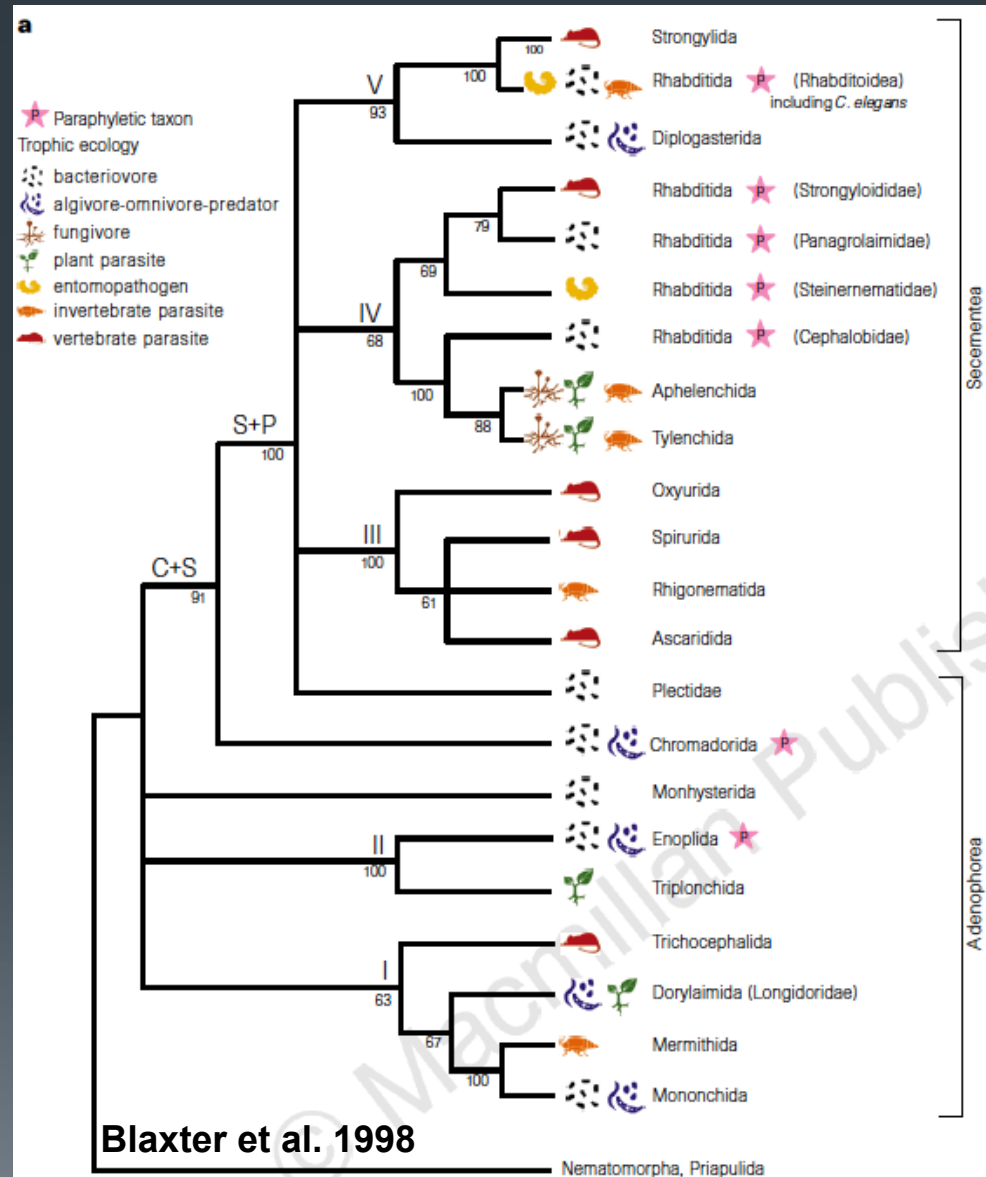
## Lorenzen 1981

- Phylum: Nematoda
  - Class: Adenophorea
    - Subclass: Enoplia
      - Order: Enoplida
  - Class: Secernentea \*
    - Subclass: Chromadoria
      - Order: Chromadorida
      - Order: Monhysterida



# Molecular phylogeny for Nematoda

- 53 nematode taxa
- small subunit rDNA
- Adenophorea paraphyletic
- Many nematode orders also paraphyletic
- Multiple origins for animal parasitic taxa; at least 3 for plant parasitism
- Origin for all nematodes: marine or terrestrial?

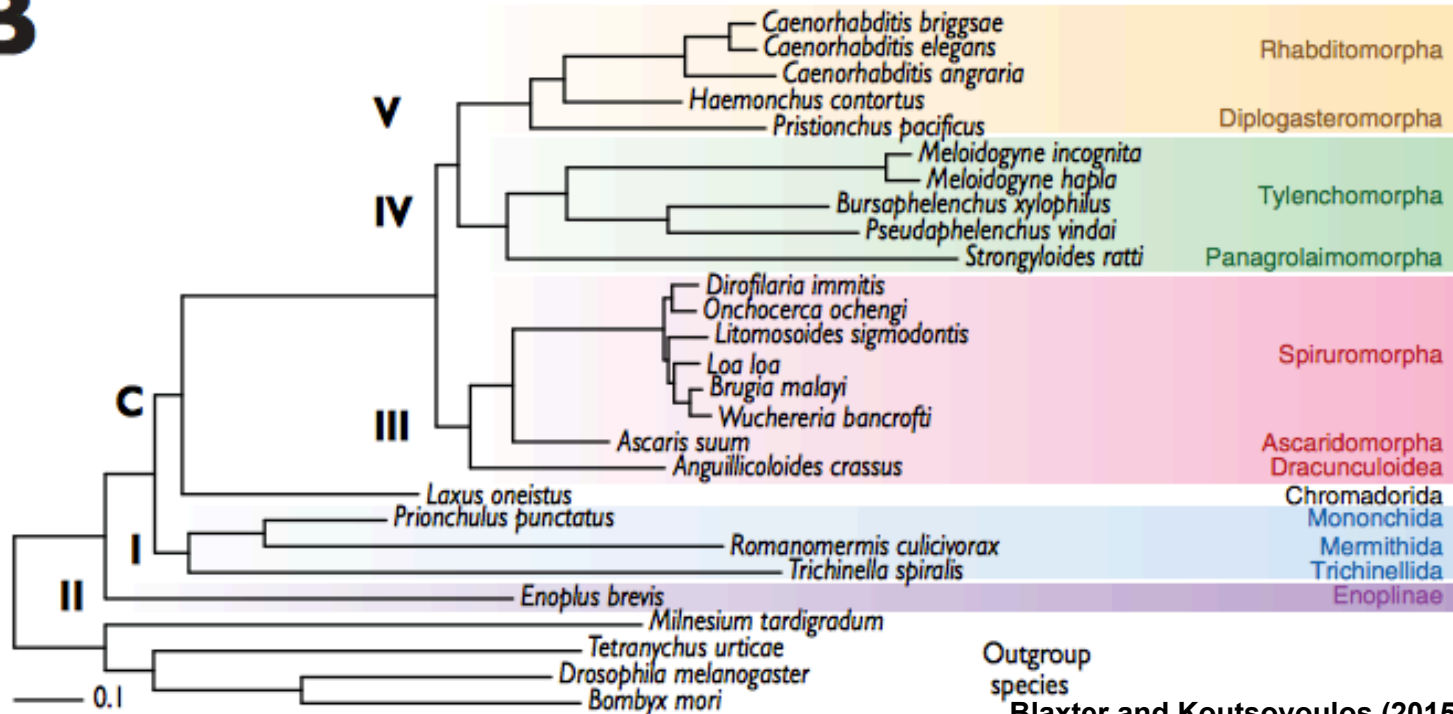




# Molecular phylogeny for Nematoda

- 181 protein coding genes
- Support for a marine origin (Enoplida are largely marine)
- Parasitism has arisen at least 15 times independently

**B**

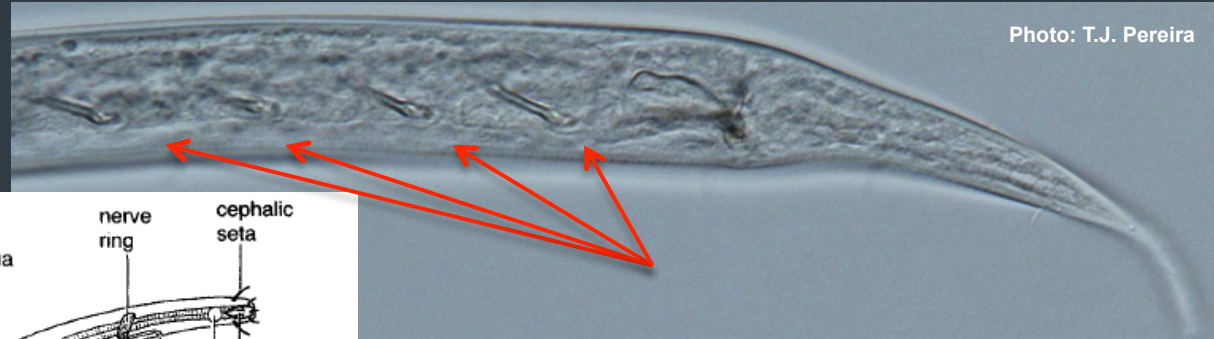


Blaxter and Koutsovoulos (2015)

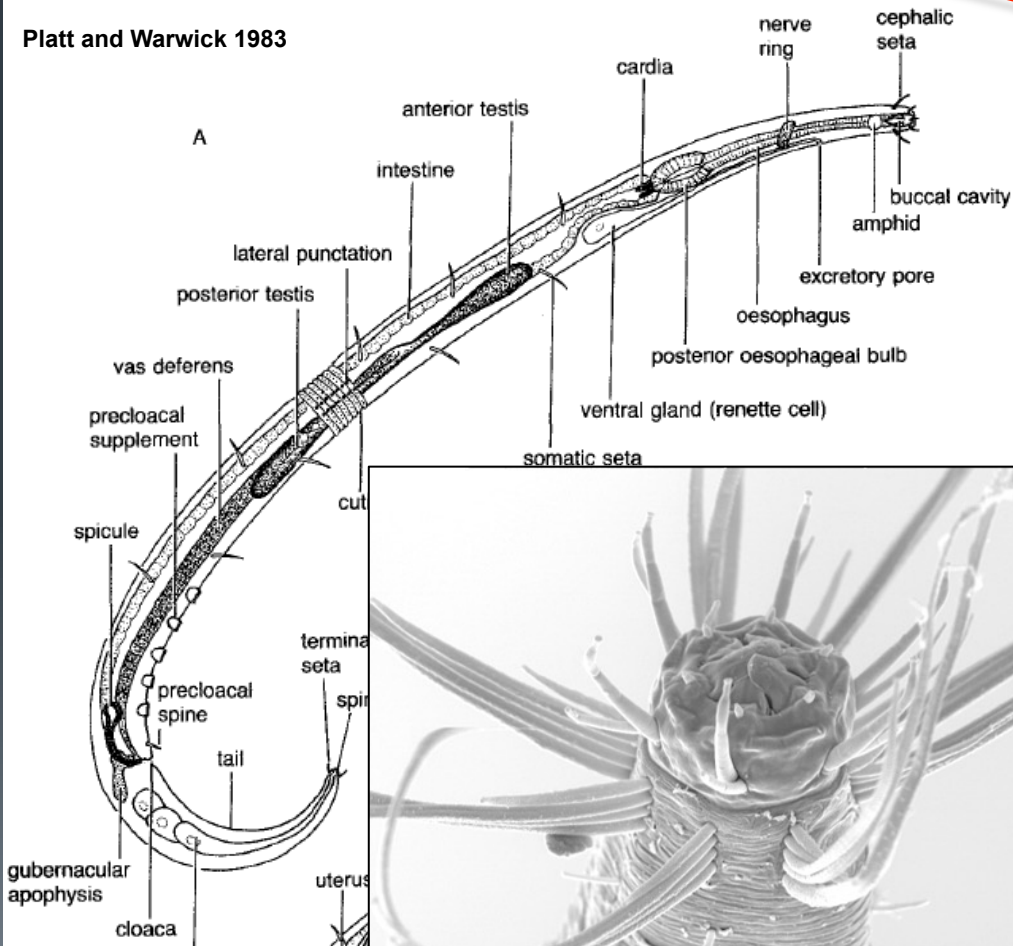


# Nematode general morphology

Photo: T.J. Pereira

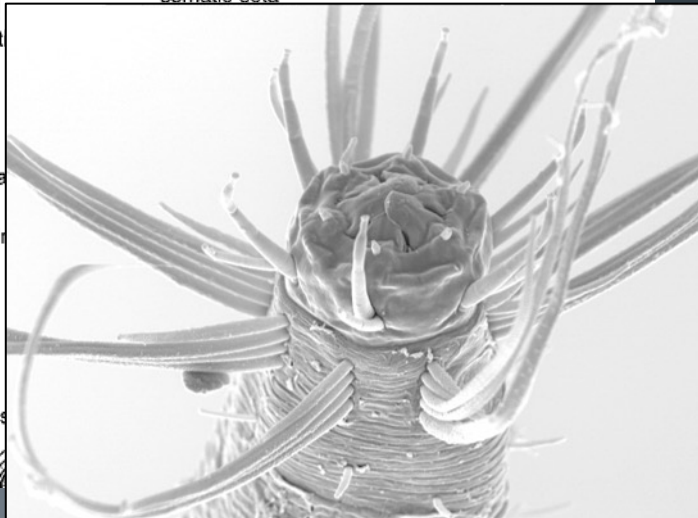


Platt and Warwick 1983

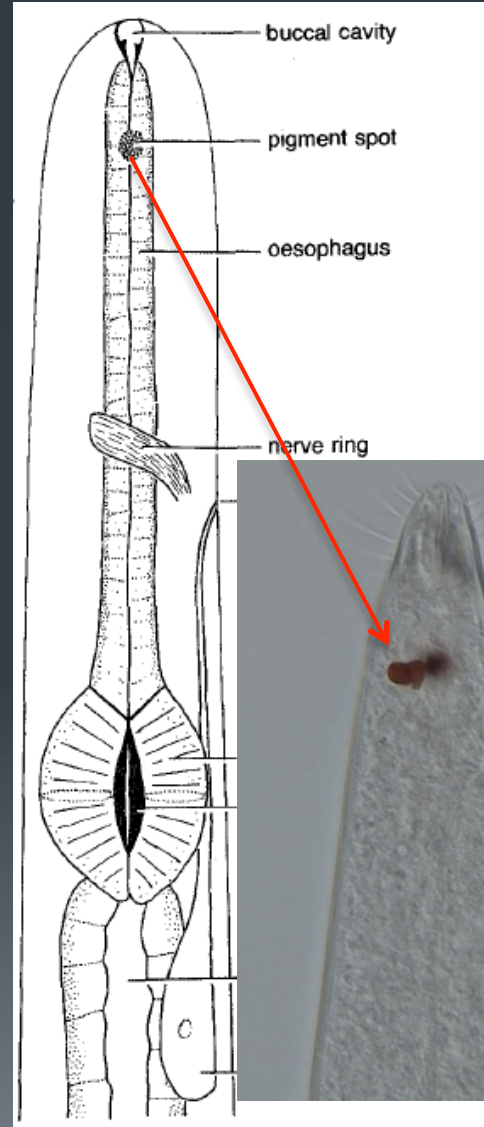
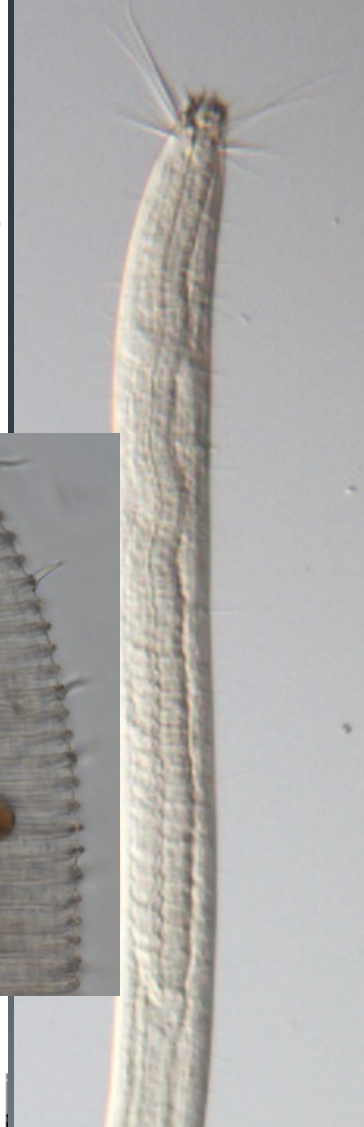
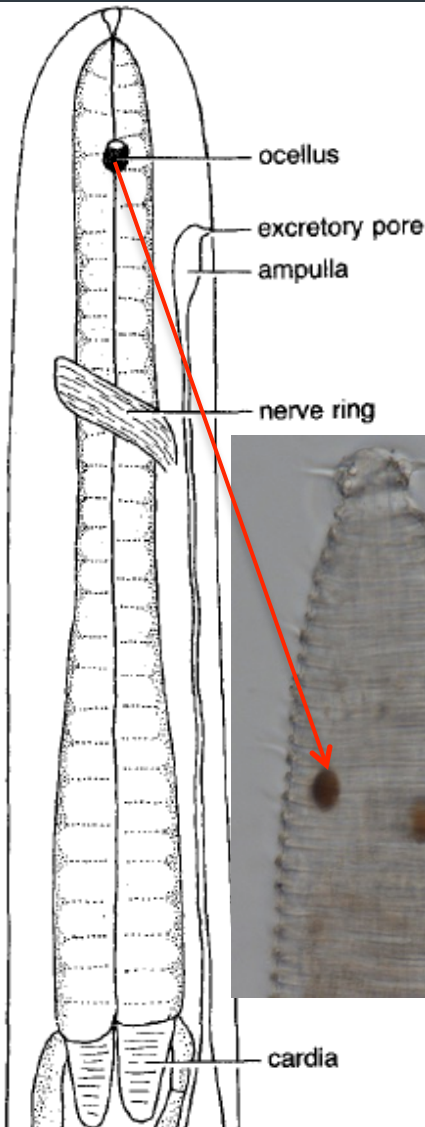


- Identification is based on male specimens
- Anterior region (mouth parts)
- Amphid shape/size
- Male sexual characters (spicule/gubernaculum and supplements)

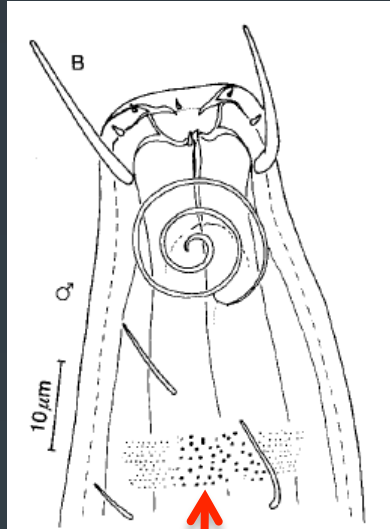
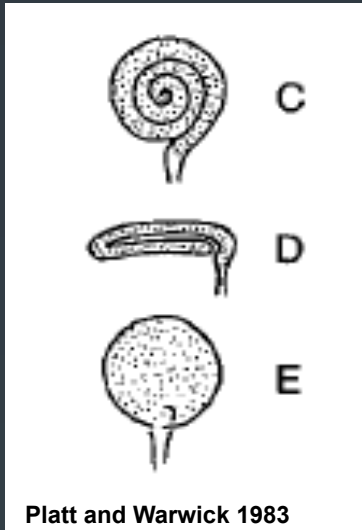
Photo: M. Mundo-Ocampo



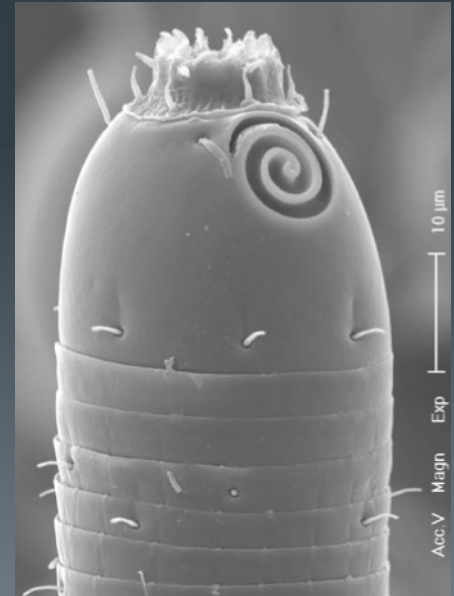
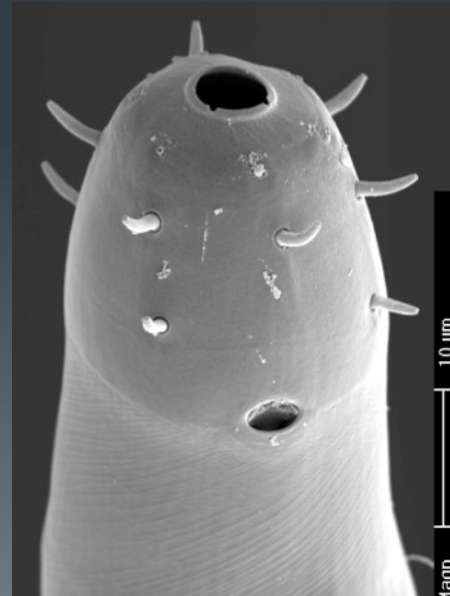
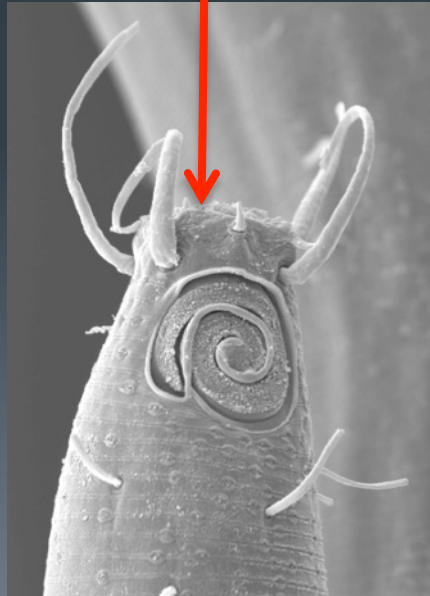
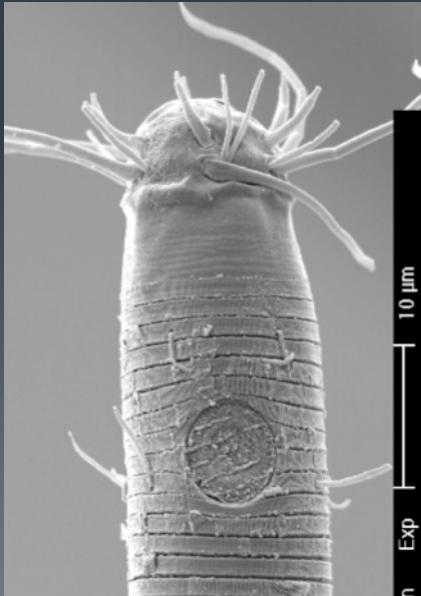
# Nematode morphology – anterior region



# Nematode morphology – amphids



- Spiral with single/multiple turns
- Transverse slit type
- Pocket shape
- Circular
- Consistent among families





# Nematode morphology – mouth

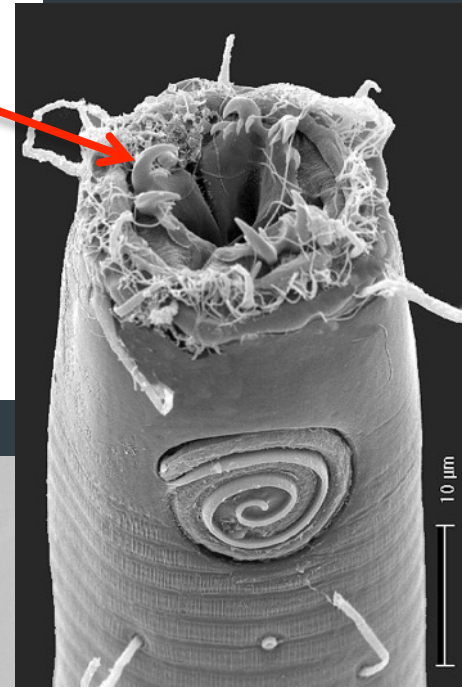
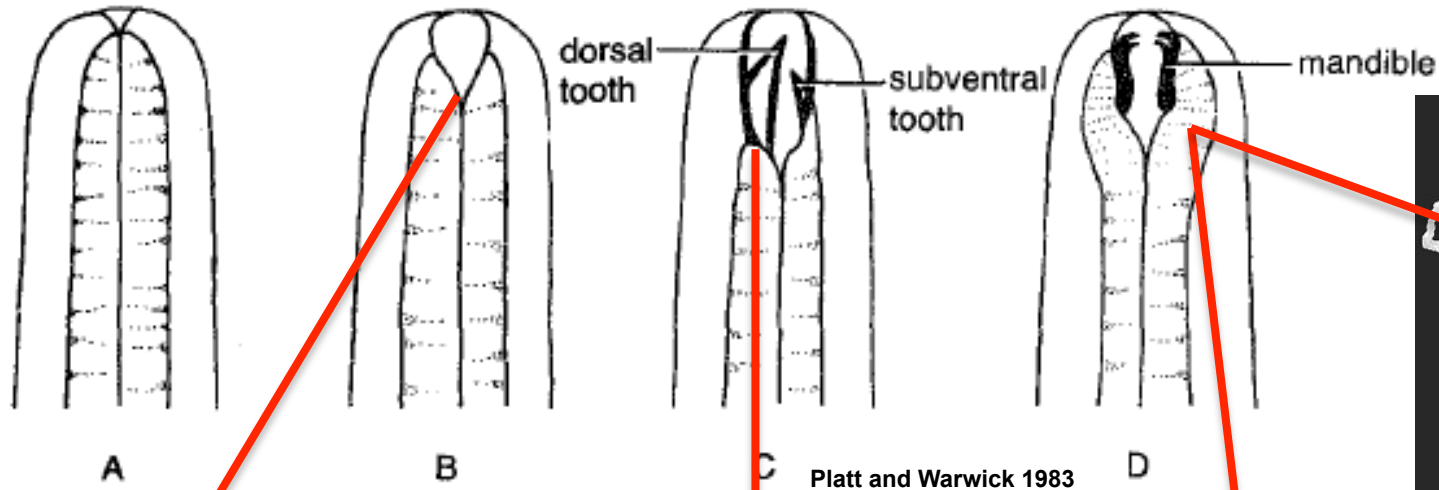


Photo: M. Mundo-Ocampo

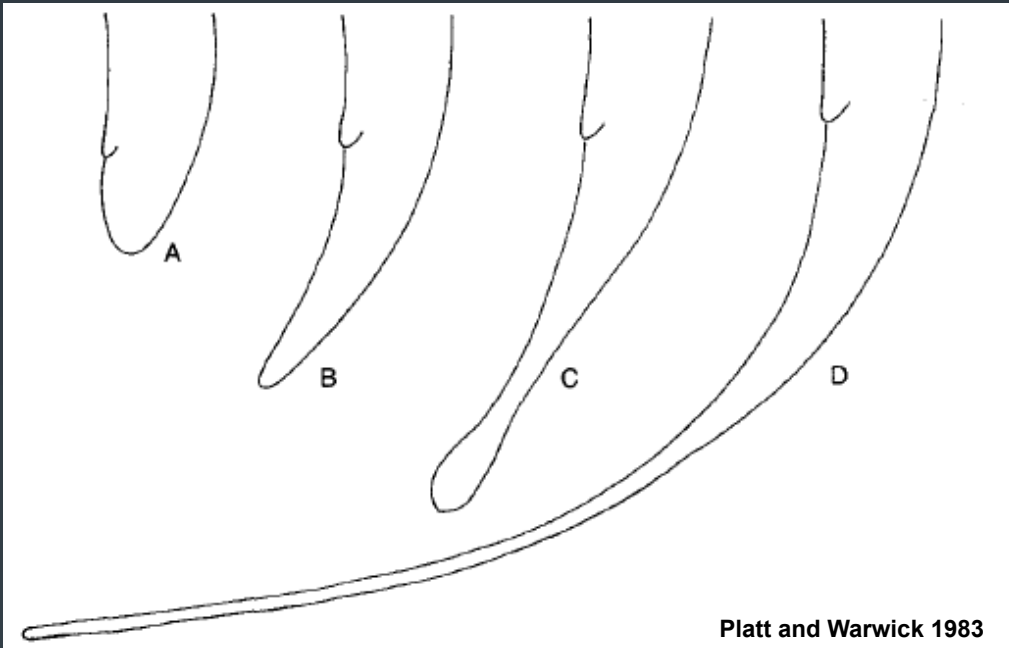


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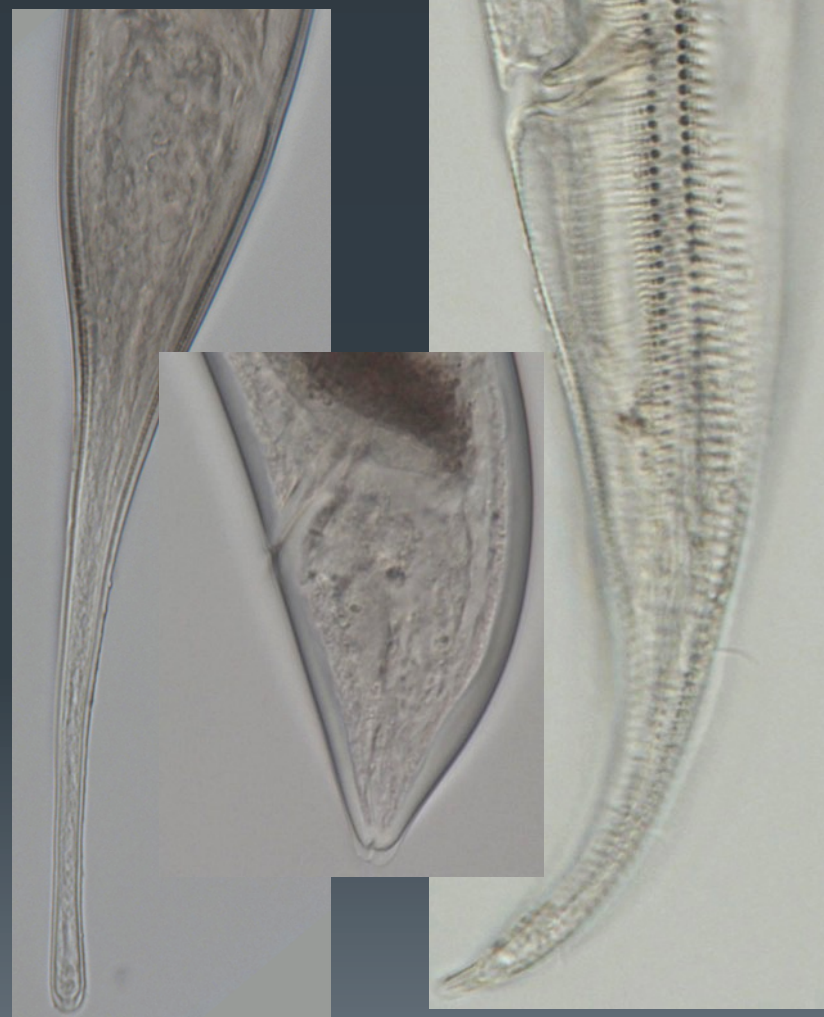


Different feeding/trophic groups

# Nematode morphology – tail



- Short and round
- Conical
- Conico-cylindrical
- Elongated/filiform



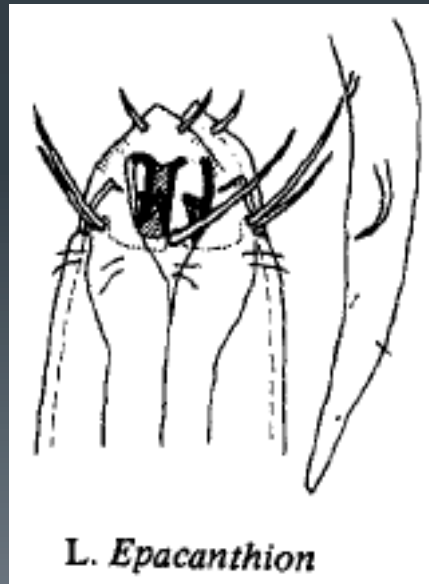
# Order Enoplida

- Relatively large nematodes (2-6 mm; more Leptosomatidae)
- Cuticle smooth (fine striations)
- Pocket shape amphid
- Armed buccal cavity (Oncholaimidae Thoracostomopsidae)



*G. Pontonema*

Platt and Warwick 1983



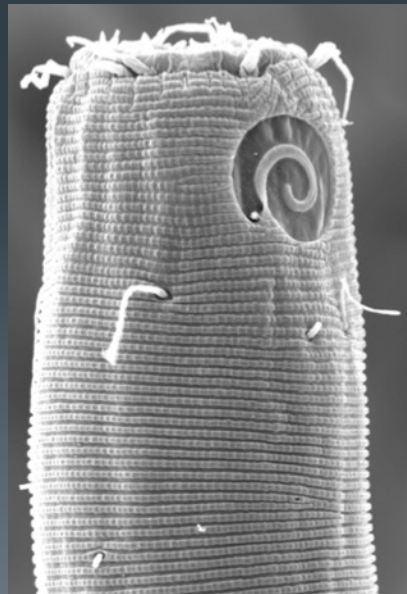
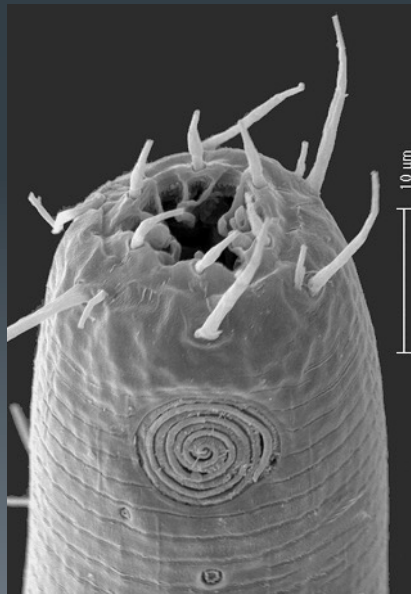
*L. Epacanthion*



Photo: T.J. Pereira

# Order Chromadorida

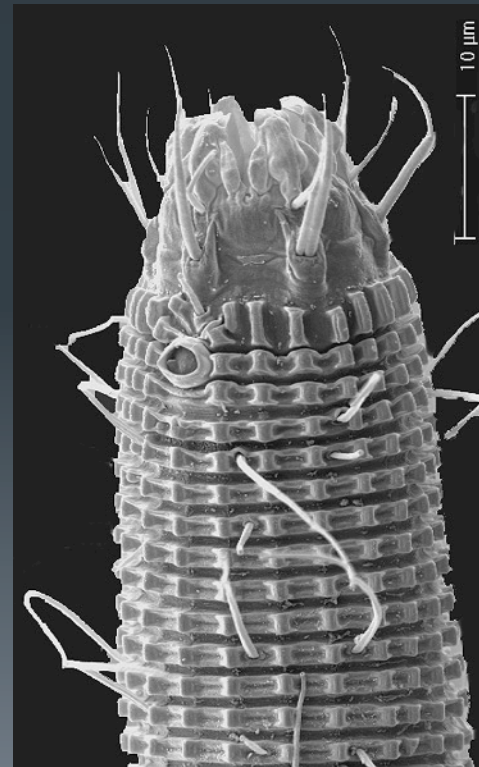
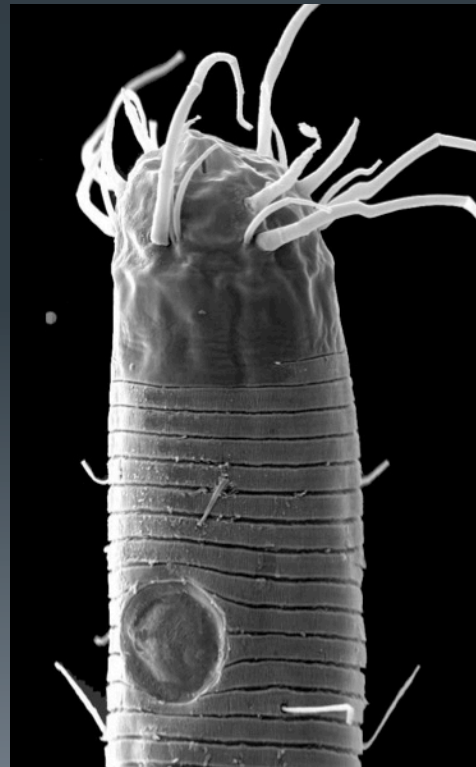
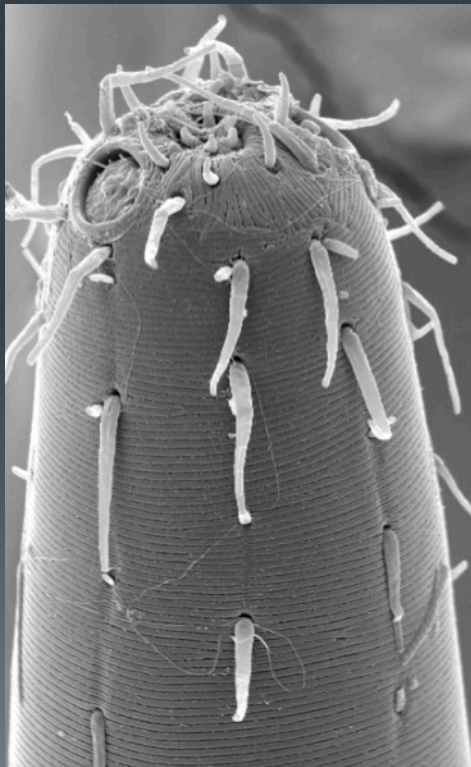
- Cuticle highly variable (different patterns); medium size
- Amphid circular, spiral, also varying in size
- Buccal cavity small; in some groups with small/large teeth/mandibles





# Order Monhysterida

- Small – medium size (less than 2 mm)
- Cuticle with fine striations; amphid usually circular
- Large number of setae; buccal cavity small



# Approaches

Sampling



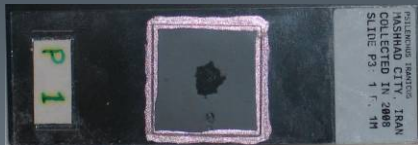
Nematode  
extraction



Washed/decanted  
in 45/63  $\mu\text{m}$

## Morphology

- LM and SEM
- Permanent mounts
- Morphometrics

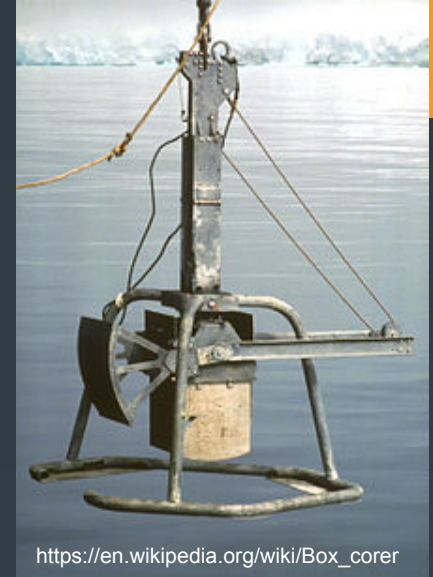


## Molecular

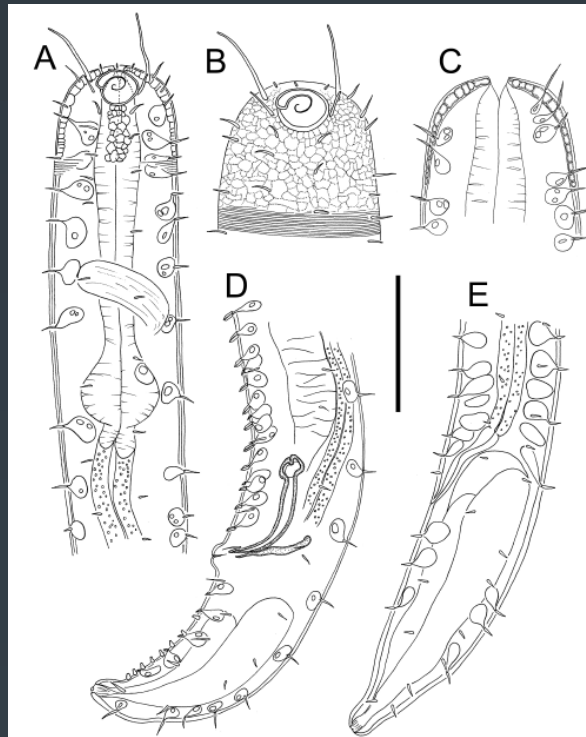
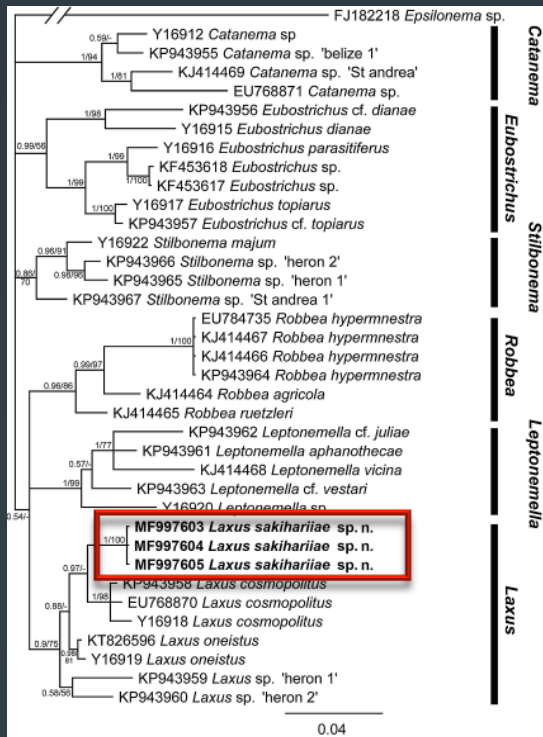
- DNA extraction
- PCR/Sequencing
- Phylogenetic analyses  
(mostly rDNA genes)



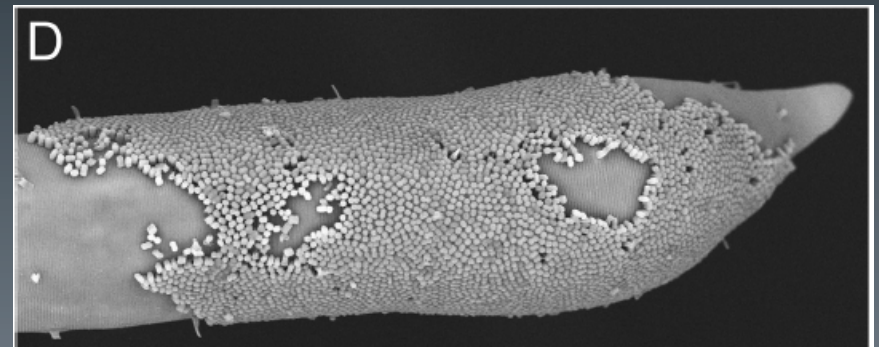
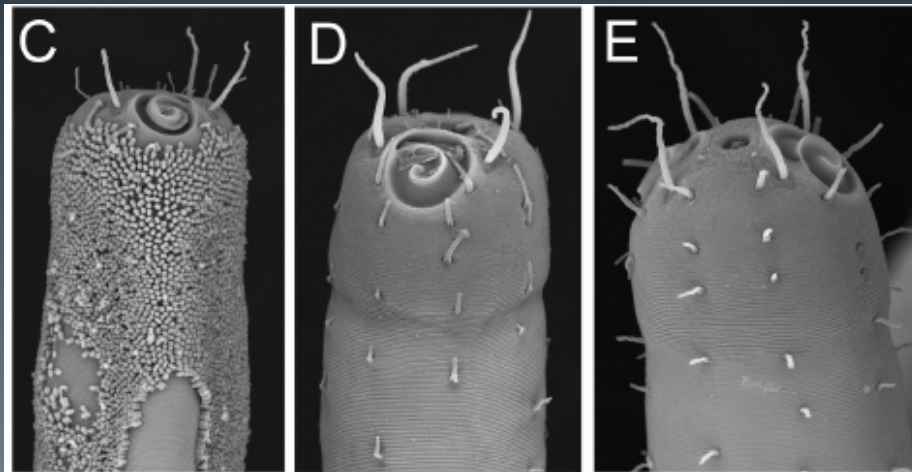
Species identification  
Species description



# Species identification/description



- Morphometrics of specimens
- Characterization based on drawings, LM and SEM photos
- Molecular data (mostly rDNA) for phylogenetic analysis



Leduc and Sinniger, 2017



# Sources for nematode identification



World Database of Free-Living Marine Nematodes

Linked to the Marine Biology Section, UGent

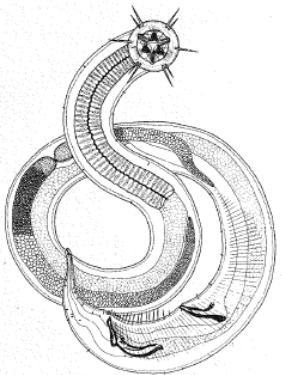
<http://nemys.ugent.be>

Synopses of the British Fauna (New series)  
edited by Doris M. Kermack and R. S. K. Barnes  
No. 28 18-054

## Free-living Marine Nematodes

Part I  
British Enoplids

H. M. Platt and R. M. Warwick



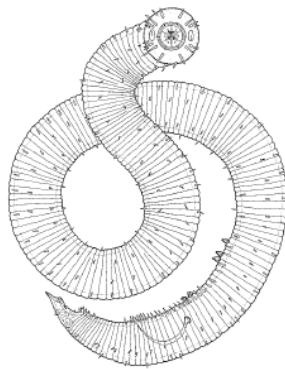
Published for  
The Linnean Society of London & The Estuarine and  
Brackish-water Sciences Association  
by Cambridge University Press

Synopses of the British Fauna (New Series)  
edited by Doris M. Kermack and R. S. K. Barnes  
No. 38 16 - 141

## Free living Marine Nematodes

Part II  
British Chromadorids

H. M. Platt and R. M. Warwick



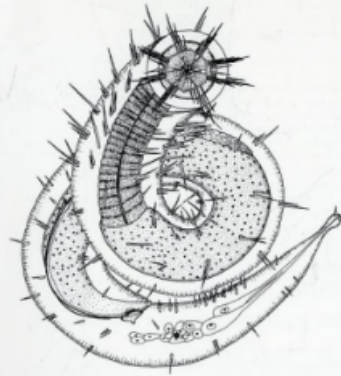
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by E. J. Brill/Dr W. Backhuys

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## Free-living Marine Nematodes Part III

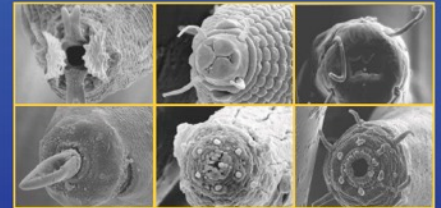
### Monhysterids

Richard M. Warwick, Howard M. Platt  
and Paul J. Somerfield



Published for  
The Linnean Society of London  
and  
The Estuarine and Coastal Sciences Association  
by  
Field Studies Council

## FRESHWATER NEMATODES: ECOLOGY AND TAXONOMY



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