BIO 221
Invertebrate Zoology I
Spring 2010

Stephen M. Shuster
Northern Arizona University

http://www4.nau.edu/isopod

Lecture 20

Phylum Rotifera

Sensory Structures:

1. Antennae, eye.
2. Brain, retrocerebral organ.

Trunk

1. Usually encased in thickened cuticle – *lorica.*
2. Well-developed musculature.

a. Circular, longitudinal muscles

b. capable of rapid retractions - characteristic movements.

3. Salivary, digestive glands along gut.

4. Stomach, occasionally intestine and cloaca.

a. Some species lack complete gut.

5. Excretory structures:

a. Protonephridia, occasionally a bladder.

b. Most waste diffuses as NH_4^+.

Phylum Rotifera

6. Possess pseudocoelom proper.

7. No special circulatory, respiratory structures.

d. Foot - already described.

Rotifera Reproduction

a. Most species gonochoristic, highly sexually dimorphic.

1. females > males

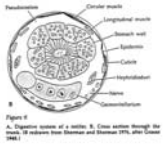
2. males possess degenerate digestive tracts - "swimming testicles."

Rotifera Reproduction

b. Female structures:

1. germinovitellarium - produces eggs and yolk

2. oviducts lead to cloaca.

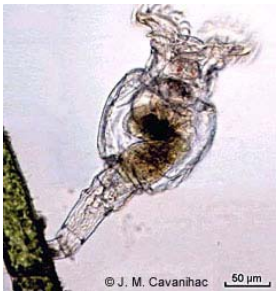


Male Structures:

1. Testis, gonopore, excretory structures.

2. Hypodermic insemination, occasionally with dimorphic sperm.

a. Some suggest two sperm types evolves in context of competition.



Amictic Cycle:

1. Mostly parthenogenetic – in constant conditions.

a. amictic eggs (2n) -> females (2n) -> amictic eggs (2n).

2. Changed environmental conditions causes sexuality.

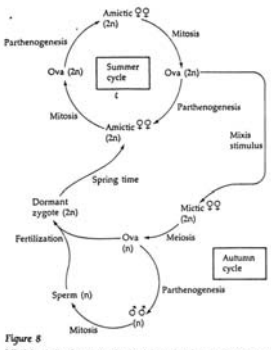


Figure 8

Mictic/amictic alternation in the life cycle of a monogonontan rotifer. See text for explanation.

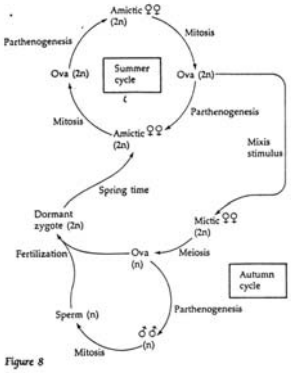


Figure 8

Mictic/amictic alternation in the life cycle of a monogonontan rotifer. See text for explanation.

Mictic Cycle:

a. Female (2n) -> mictic egg (n).

1. unfertilized -> male (n).

2. Fertilized -> resting egg (2n) -> amictic female (2n).

Rotifer Sex:

3. Often used as a model to demonstrate evolutionary significance of sex.

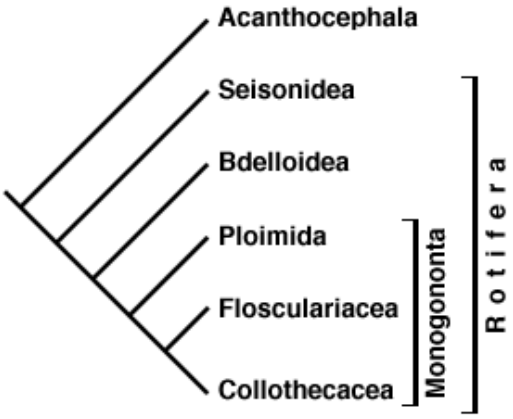
a. Rapid population growth assists in exploitation of temporary environments.

Development:

4. Direct development; spiral, determinate cleavage (Protostomous).

1. Sessile forms may have motile "larval" stage

2. Really just small, unattached adults.



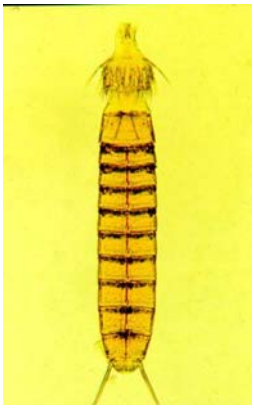
Phylum Kinorhyncha

General Characteristics:

1. Small, relatively poorly known despite discovery in mid-1800s.

1. 150 spp.

2. In marine, interstitial habitats, commensal w/sponges, hydroids.



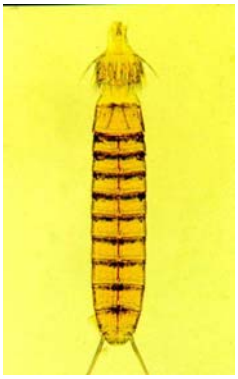
Phylum Kinorhyncha

General Characteristics:

2. Triploblastic, bilaterally symmetrical, segmented pseudocoelom.

1. Suggests affinity w/ annelids.

2. Appears convergent - (movement).



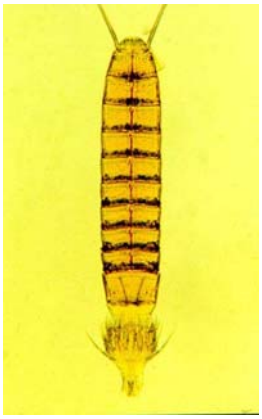
Body Form:

1. Divided into 13 segments (zonites).

a. Reflected in internal musculature.

1. Dorsolateral, ventrolateral muscles - top and bottom.

2. Diagonal muscles - between segments.

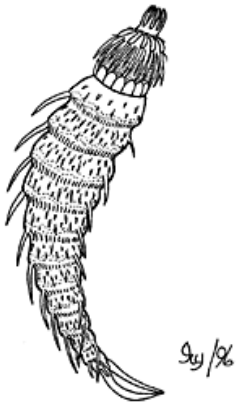


Body Form:

b. Nervous system also segmented.

c. Segmentation appears to permit movement through substrate.

d. cuticle is shed with growth.



Body Form:

2. Head is cone-shaped (coneheads), oral stylets on "snout."

a. Zonites possess spines, dorsal, ventral plates.

3. complete gut, apparently deposit feeders, poorly known.

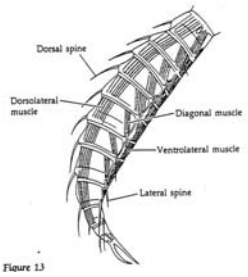
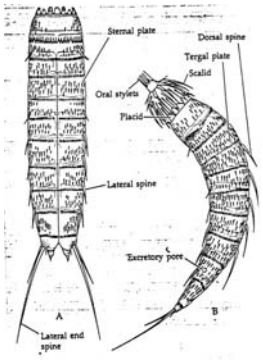


Figure 13

Body Form:

4. Like other phyla, no circulatory, respiratory structures.

a. Protonephridia - solenocytes (2) for osmoregulation.

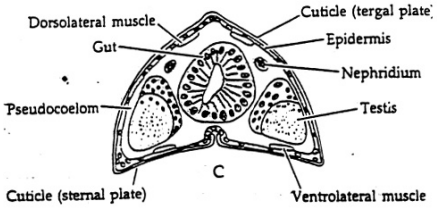


Reproduction:

1. Poorly known, but separate sexes exist.

a. Possess sperm storage organ.

b. Suggests multiple mating, possible sperm competition.



Reproduction:

What can we say about mating systems based on evidence that multiple mating can occur?

1. Mate guarding.
2. Sperm allocation.
3. Sperm polymorphism.
4. Alternative strategies.

Development:

2. Appears direct, with egg shell around zygotes.

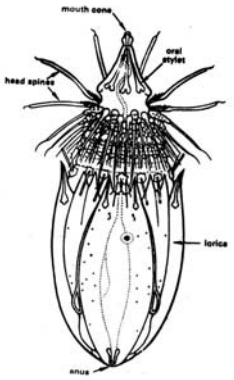
3. Determinate growth; like humans.

Phylum Loricifera

General Characteristics:

1. A recently discovered phylum (Kristensen 1983) from shell-gravel sediments.

a. Now know to occur at great depth.

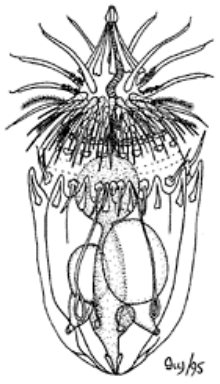


Phylum Loricifera

General Characteristics:

b. N species unknown, now about 35-40.

2. Bilaterally, radially symmetrial, unsegmented, apparently psuedocoelomate.



Body Form:

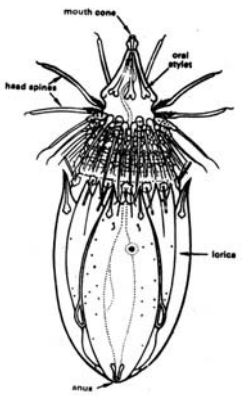
a. Extremely tiny, 1/4 mm long.

b. Head, neck, and thorax retractable into abdomen.

1. Spines encircle cone-shaped mouth.

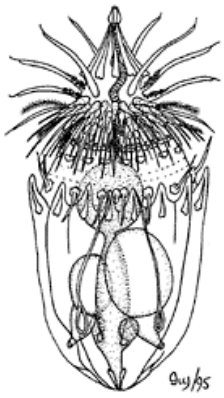
c. All surrounded by cuticle - lorica ("corset-bearers").

d. complete gut, diet?



Locomotion:

e. Appear to propel themselves along with spines and toes.



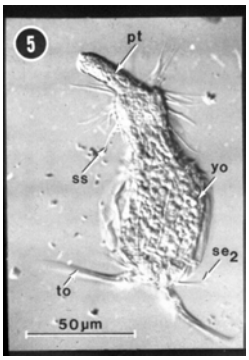
Reproduction:

a. Poorly known like rest of group.

b. Sexes separate, sexually dimorphic in head scales.

c. unique "Higgins-larva" named after co-discoverer.

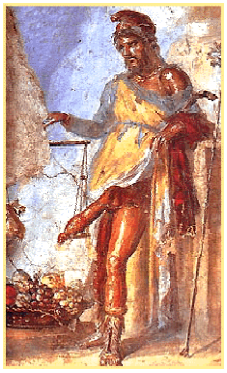
1. originally thought to be a larval priapulan.



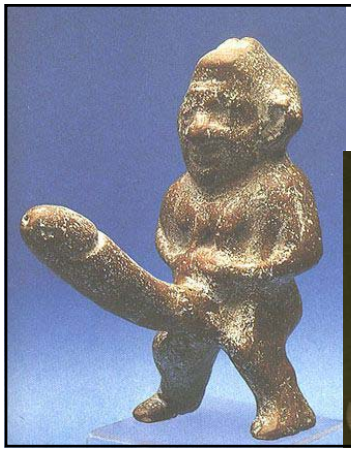
Phylum Priapula

General Characteristics:

1. Named after the Greek god *Priapos*, although actual name-sake reported by B&B to be from Linnaeus (*Priapulus humanus*) - human penis.



K38.1 Priapos



Πριαποσ

Priapulus humanus

"little human penis"

a. Reported to be up to 20 cm long (>9 inches!)

b. More often smaller (8 cm (=3 inches)

b. Anterior end armed with spikes.

Body Form:

a. Bilaterally symmetrical, superficially annulated.

b. Armed anterior end (introvert) that is retractable.

1. Burrowing forms, structure assists in food capture.

Feeding:

a. Extend introvert, hook prey, contract muscles and draw prey in.

Body Form:

c. Radially arranged nervous system located near surface of body

d. Complete gut - often with diverticulae.

e. Numerous protonephridia associated with the reproductive tract.

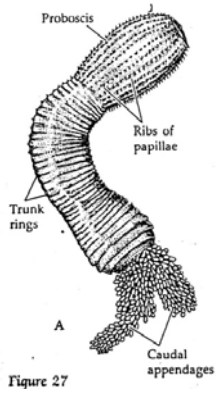


Figure 27

1. Amounts to a true urogenital system - observed in more derived forms.

2. May assist habitation of sediments in hypo- and hypersaline environments.

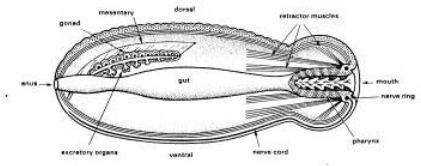


Diagram of a priapulan in lateral view, cut lengthwise just to the right of the midline. Shown in black are the cut ends of the nerve ring around the pharynx and the median ventral nerve cord, which lies in the epidermis. The pharynx has been cut open to reveal its spiny lining. The left gonad, the excretory organs, and their duct are shown suspended by a mesentery from the lateral body wall. The retractor muscles of the introvert also attach to the body wall. (Adapted from Delage and Hérouard)

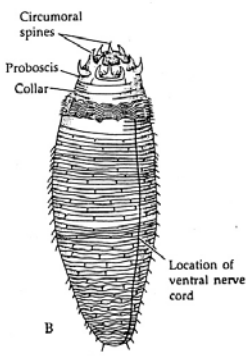
Body Form:

f. Unique (apparently) respiratory structure - *caudal appendage.*

1. No apparent effect if removed, however.

Phylogenetic Position:

3. Unusual group- difficult to place due to affinities to pseudocoels and eucoels.



With Pseudocoels?

1. Cuticle, periodially shed (Ecdysozoa).
2. Fluid filled body cavity, movement assisted by hydrostatic pressure.
3. lorica-encased larva - very similar to Loriciferans.

With Eucoels?

1. Body wall is lined - but lining does not cover internal organs.
2. Yet extensions do support viscera.
3. Overall, difficult to classify.

Reproduction:

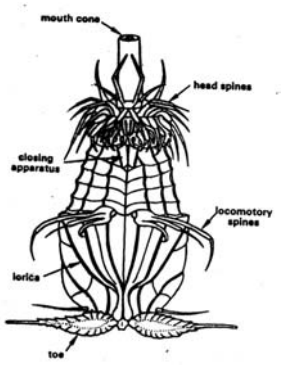
a. Gonochoristic, but copulation doesn't occur – spawning instead.

b. Males first, female second - interesting, this is unusual for external fertilizers.

Development:

c. Is unusual for pseudocoels: radial holoblastic cleavage.

d. Produces loricate larva.



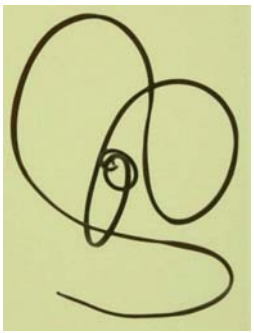
Phylum Nematomorpha

General Characteristics

1. Wierd, once thought to represent spontaneous generation.

a. Adults occur in horse troughs.

b. attempts to revitalize horsehairs failed.



Phylum Nematomorpha

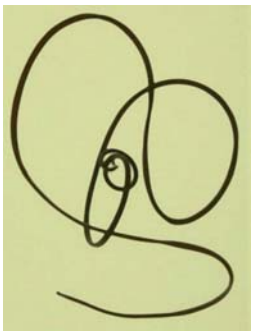
General Characteristics

2. Fairly abundant - 230 spp

3. Body form

a. Similar to nematodes

1. thick cuticle must be molted.

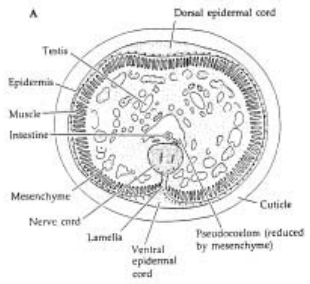


Phylum Nematomorpha

General Characteristics:

2. Longitudinal muscles.

3. No ciliated structures.



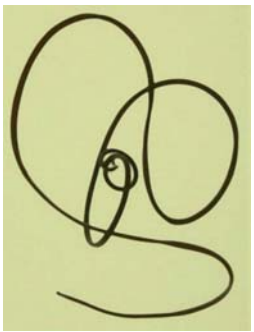
Phylum Nematomorpha

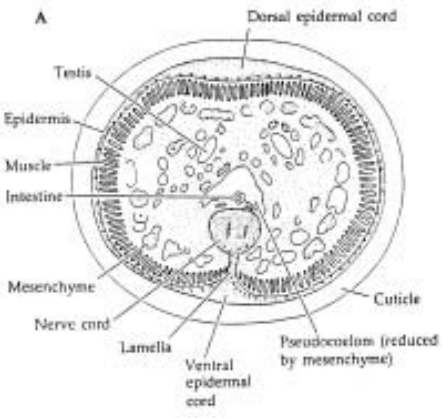
Dissimilar to Nematodes.

1. Do not show consistency in cell number (eutely).

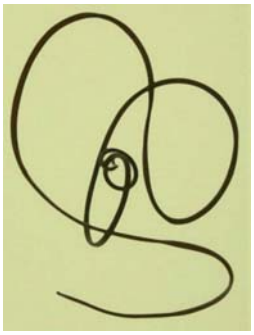
2. Pseudocoel filled with mesenchyme.

3. Rudimentary digestive system.





Phylum Nematomorpha

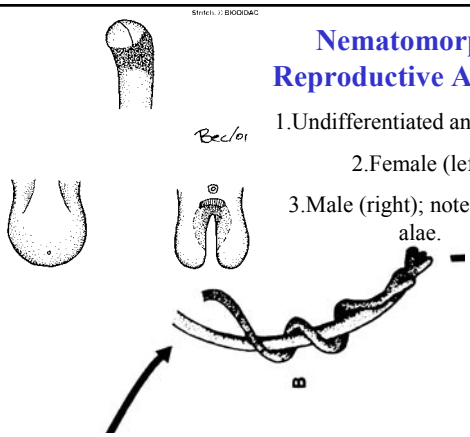


Dissimilar to Nematodes.

a. nutrients absorbed from body of insect host.

3. No excretory system

4. No specialized genital system - cloacas in both sexes.



Nematomorpha: Reproductive Anatomy

1.Undifferentiated anterior end.

2.Female (left)

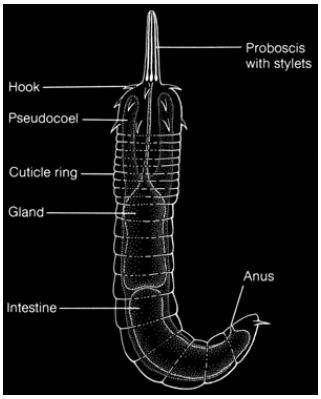
3.Male (right); note clasping alae.

Nematomorpha: Life Cycle

a. Adults develop in bodies of insects.

1. Cause hosts to seek water, once entering, they explode.

2. Separate sexes mate in water.

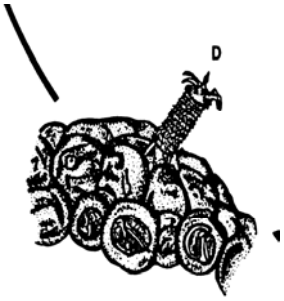


Nematomorpha: Life Cycle

a. Females lay eggs that wrap around aquatic vegetation.

3. Eggs hatch, larvae remain free living for only a few days.

Nematomorpha: Life Cycle



4. Larvae ingested by host- when insects feed or drink near water.

a. Use hooked proboscis to imbed in tissues

Nematomorpha: Life Cycle

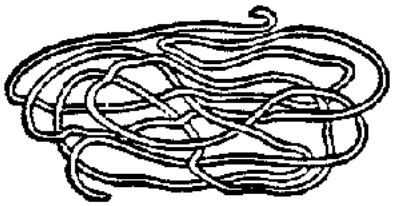
b. If unsuitable host ingests, will encyst and wait for intermediate host to be ingested by suitable host.

1. Beetle -> mantid

Nematomorpha: Other Hosts

2. Can also inhabit annelids, molluscs, crustceans, humans

5. Mature worm develops beneath skin.



Horsehair (Gordian) Worm

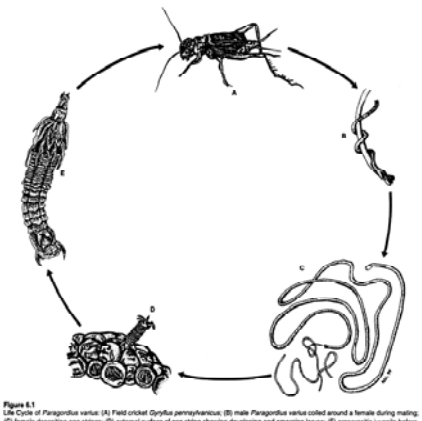


Figure 8.1
Life Cycle of *Paragordius varius*: (A) Field cricket *Gryllus pennsylvanicus*; (B) male *Paragordius varius* coiled around a female during mating; (C) female depositing egg strings; (D) external surface of egg string showing developing and emerging larvae; (E) preparasitic juvenile before entering host.

Phylum Nematomorpha

Reproduction -

a. Example: *Gordius* after the Gordian Knot.

1. intricate knot tied by King Gordius of Phrygia

a. whoever untied it would be King of Asia.