Arthropods

Lec 14
fish310

Phylum Arthropoda

Class Crustacea
- Subclass Malacostraca
  - Order Isopoda—pillbugs, woodlice
  - Order Amphipoda—sand fleas
  - Order Euphausiacea—euphausiids (krill)
  - Order Stomatopoda—stomatopods
  - Order Decapoda—crabs, lobsters, shrimp, hermit crabs
- Subclass Branchiopoda—brine (fairy) shrimp, clam shrimp, water fleas
- Subclass Ostracoda—the ostracods
- Subclass Copepoda—the copepods
- Subclass Pentastomida
- Subclass Cirripedia—the barnacles

Phylum Arthropoda

But first...

- a little appendage loss
- reproduction
- development

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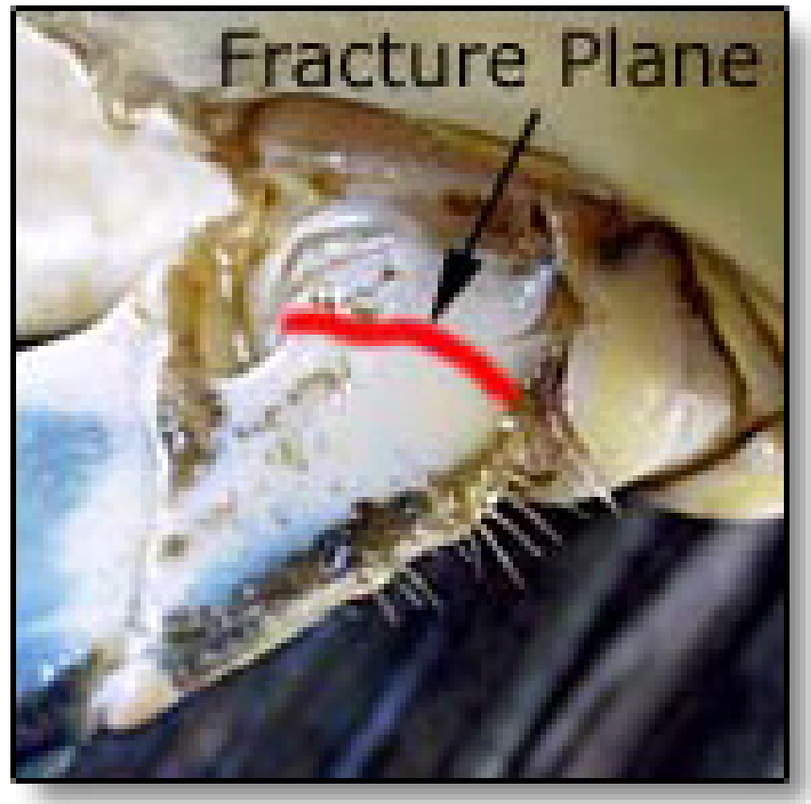
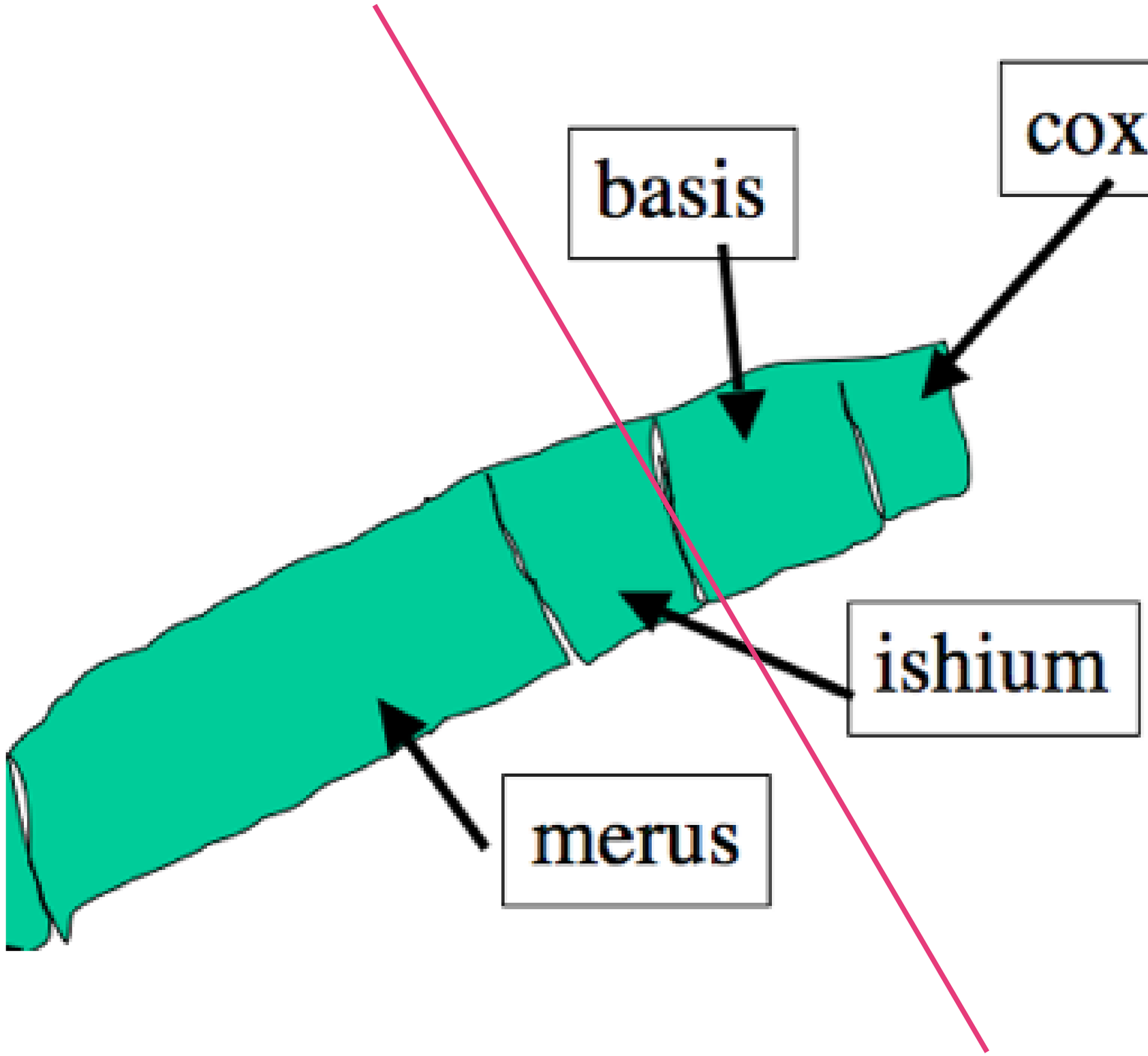
Autotomy

- **Controlled response to trauma**
  - **Pre-formed breakage plane**
  - **Typically only on appendages likely to be lost**
- **predator grabbing limb**
- **limb damaged – stop blood loss**
- **temp or chemical stress**
- **starvation**


Fracture Plane


basis
coxa
ishium
merus

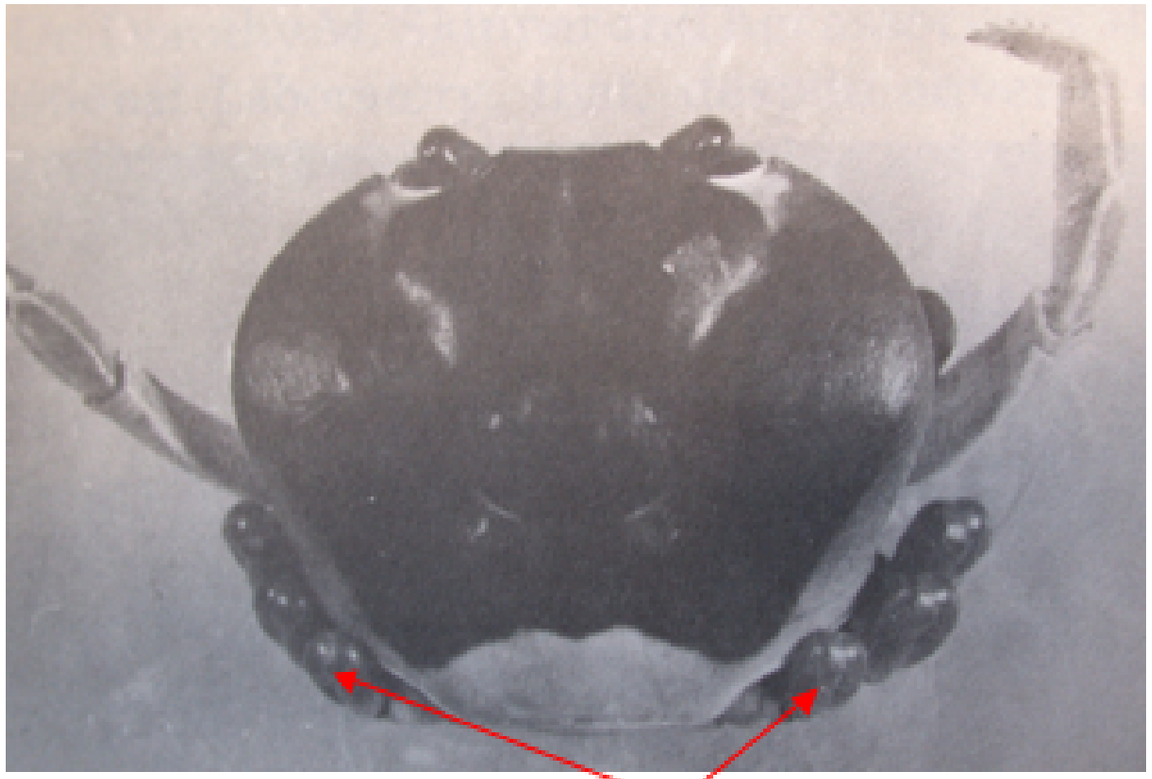
Autotomy

- leverage against the coxa used
  - Several muscles involved in coordinated effort
- little pressure to break-
  - *Carcinus* 125-385 grams pressure to break against coxa
  - 3.5-5 kg pulling in straight line

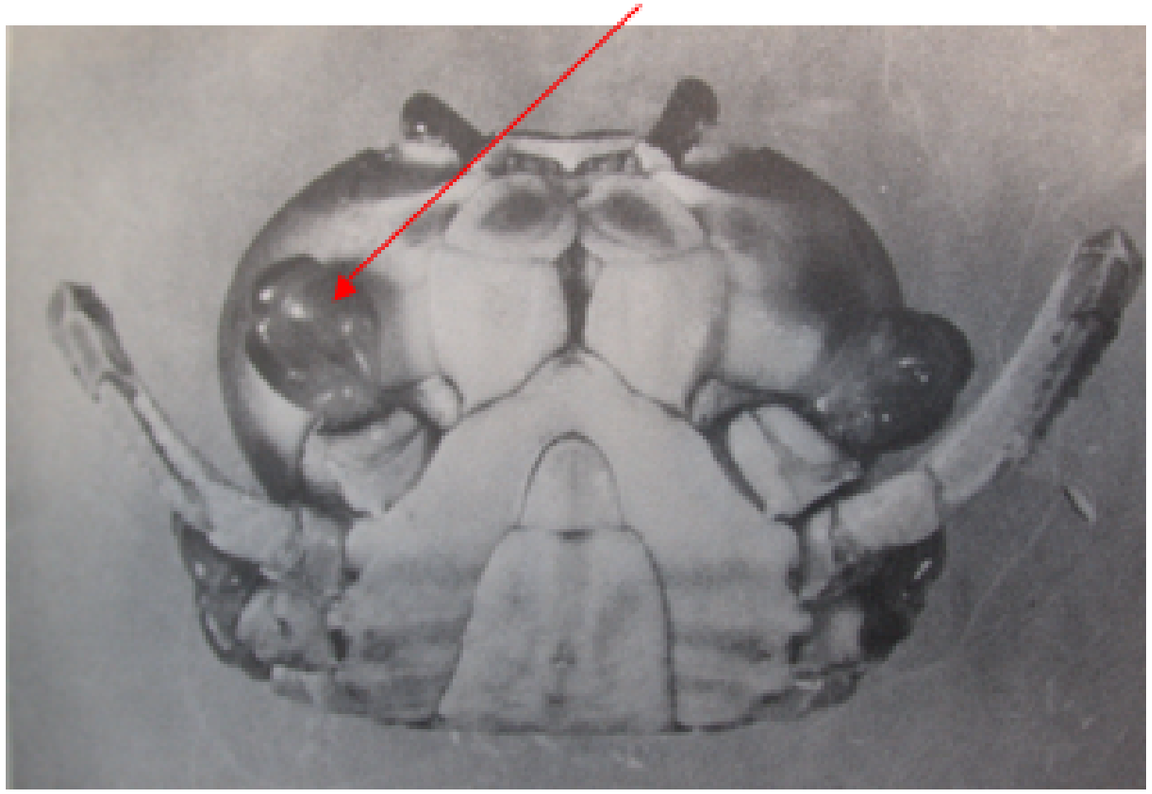
Before

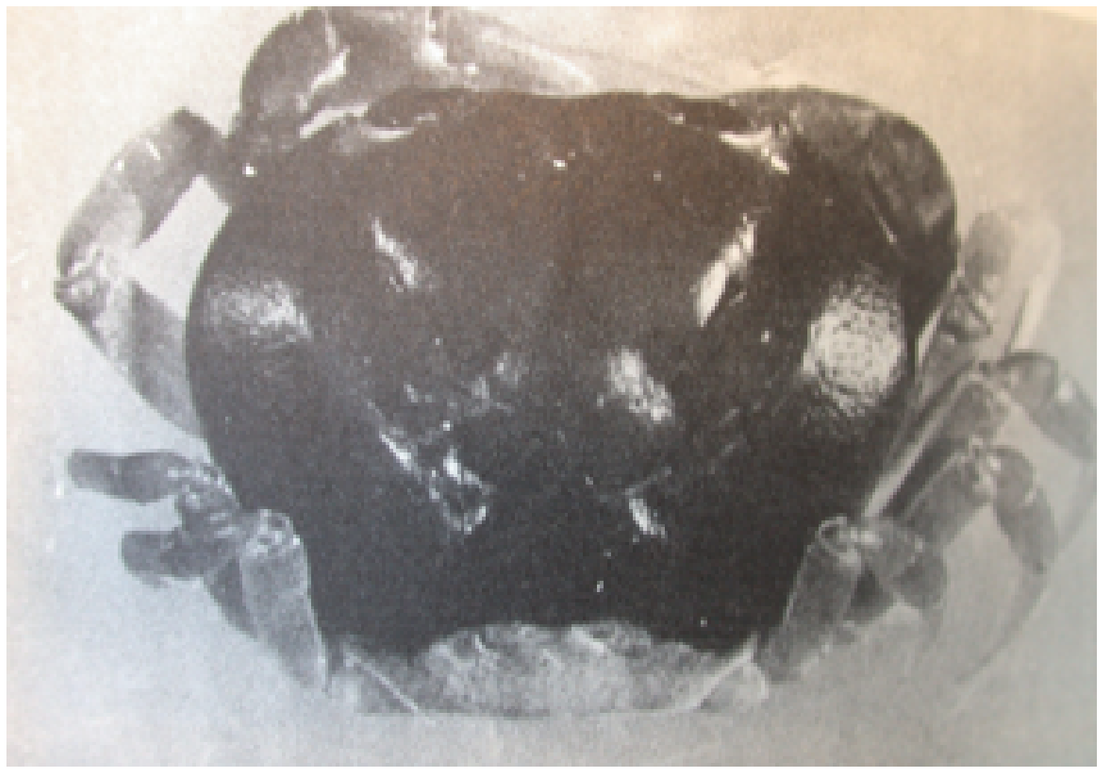
After

Petrolisthes eriomerus



Limb buds





Bliss

Reproduction

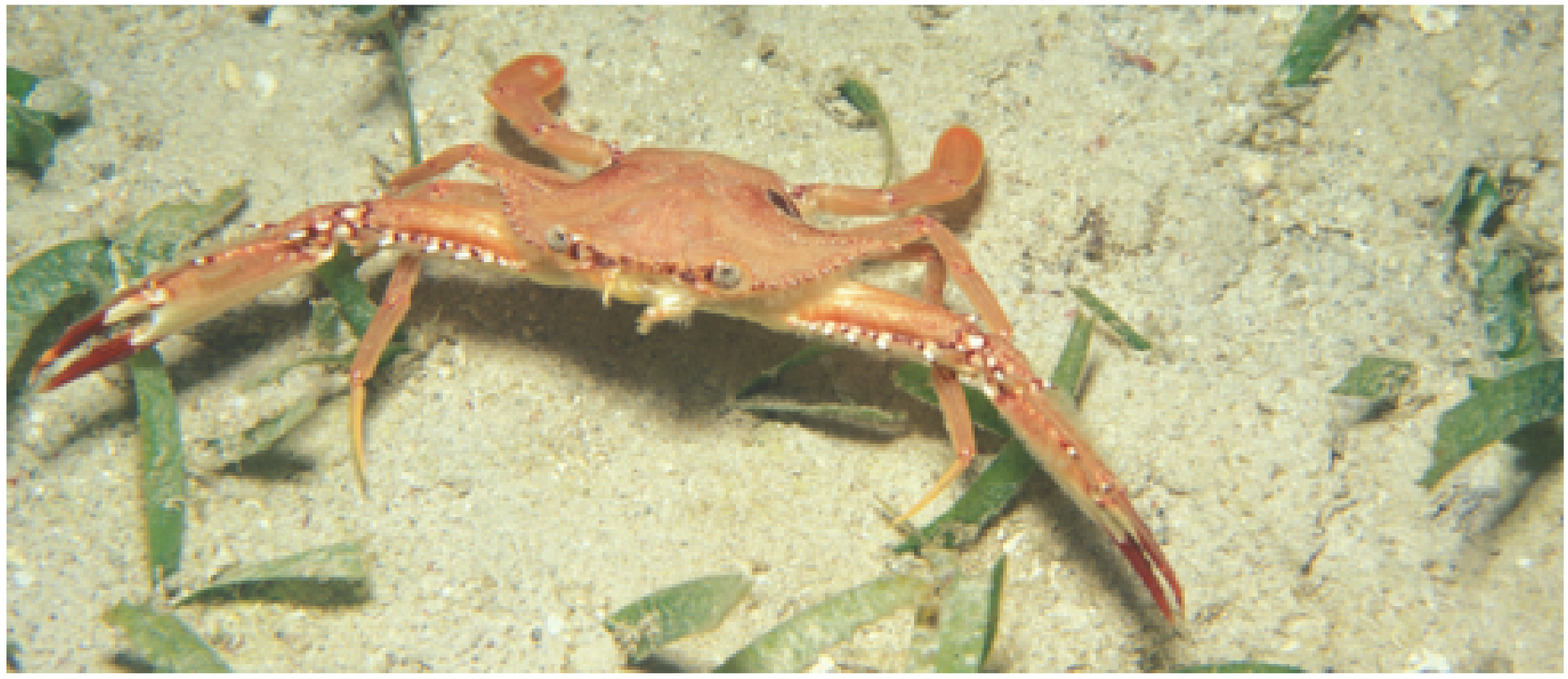
Pheromones

- **Strict definition: "Chemical produced by an organism that influences the behavior of another"**

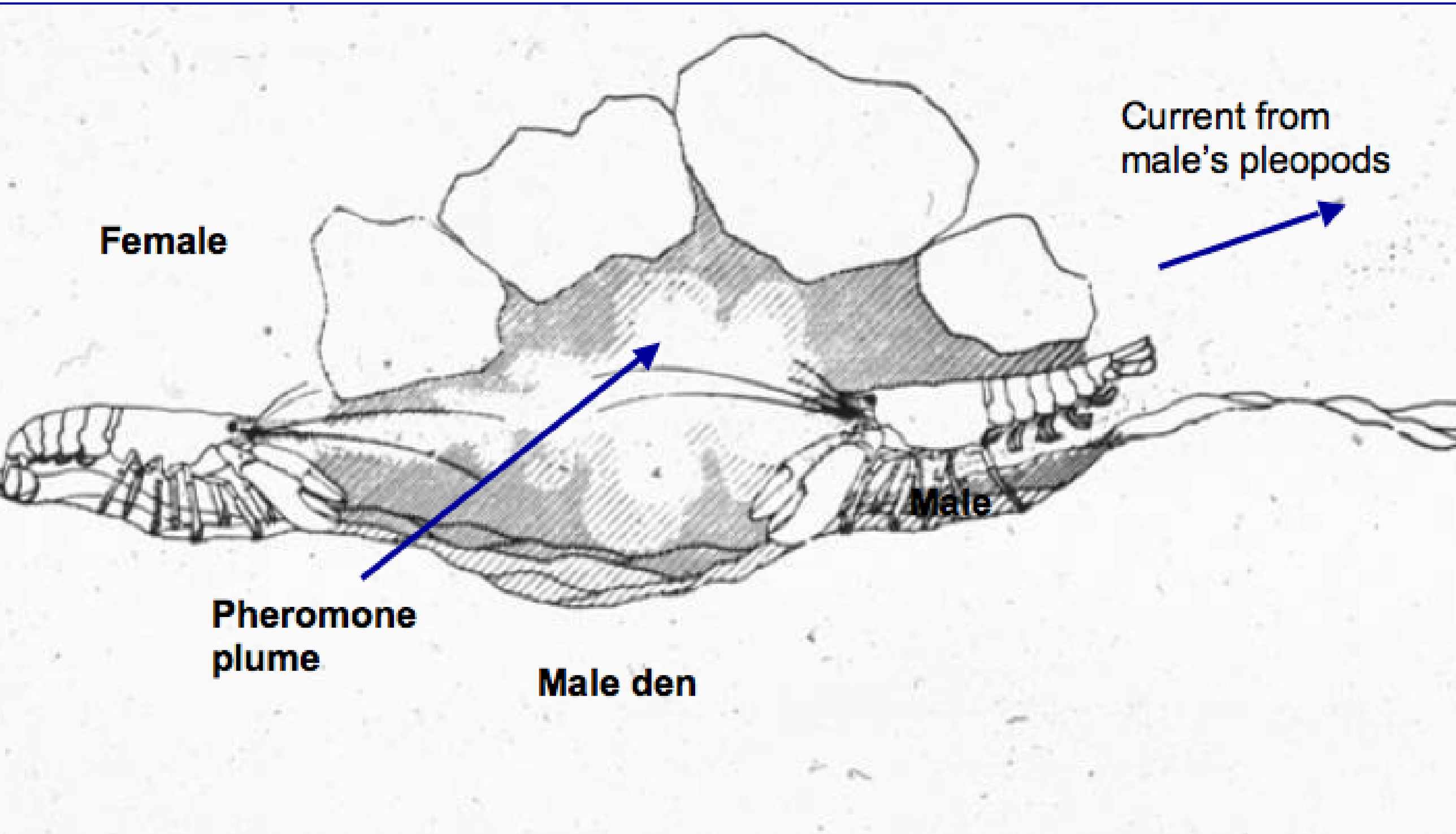
- **Most crustacea mate when female is soft-shelled**
  - **Males usually attracted by sex pheromone**

Pheromones (evidence)

- ***Portunus*- urine from premolt female attracted males**
- **No response if:**
  - **Female not sexually mature**
  - **Excretory pore of female blocked**
  - **Female was of different species**
  - **Water was from premolt *male* tank**



Pheromones



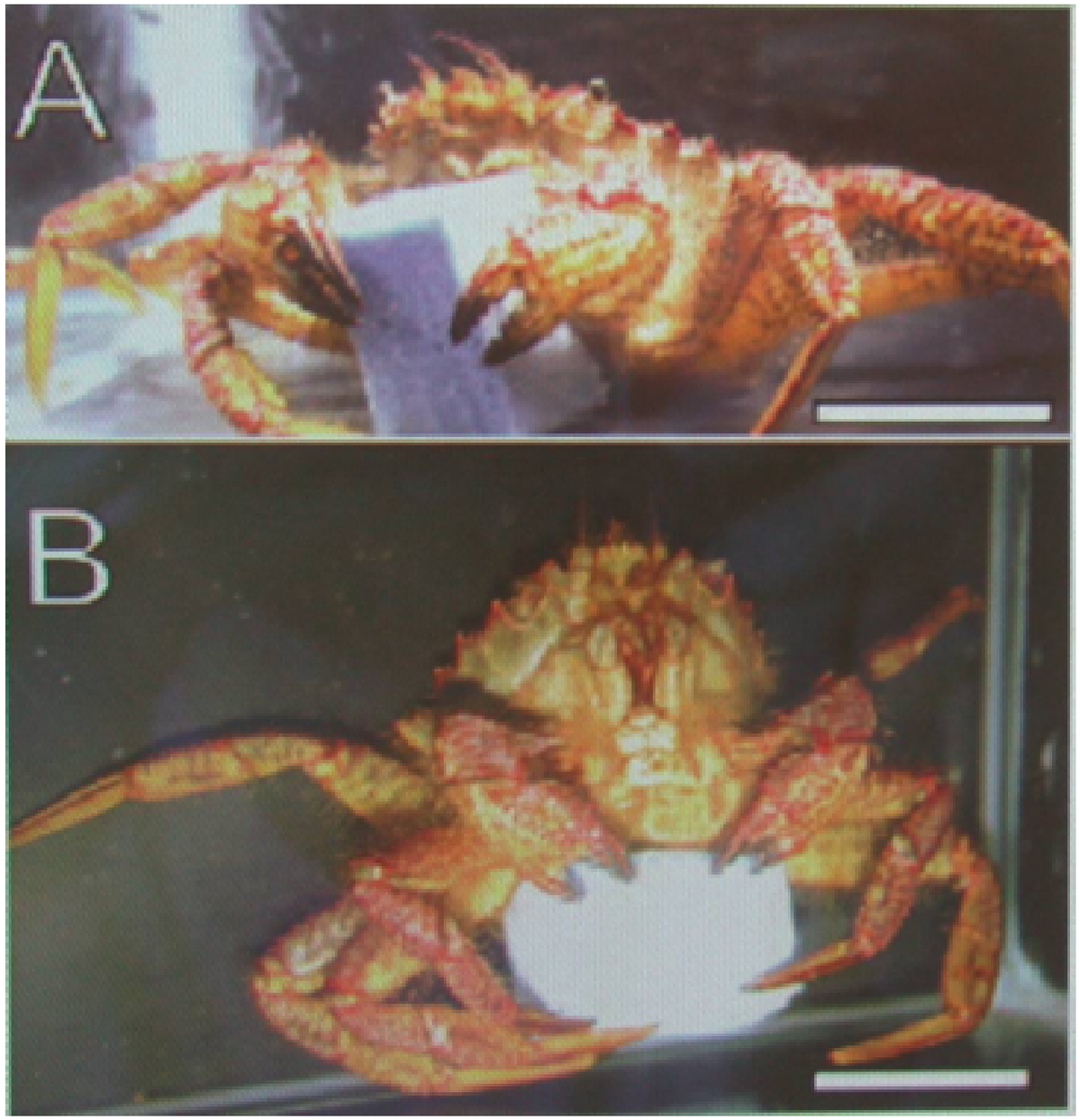
Atema 1986

Pheromones

Breithaupt & Eger

Pheromones

Kamio et al 2002



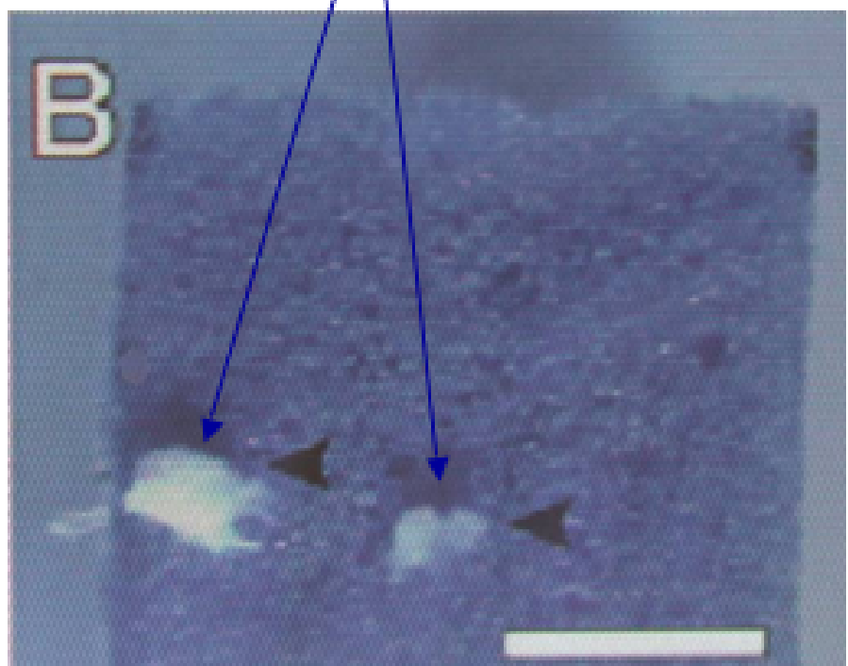
Telmessus

Copulation pheromone

Source unknown; not antennal gland

A local species that has been shown to have a copulation pheromone that females release for 21 days after molting. Shows a poor male mating with a sponge block that was soaked in water from a female's tank.

Sperm plugs on foam



Mate Attraction

- Aquatic species use olfactory (pheromonal) and tactile cues

Terrestrial?

Mate Attraction

- Aquatic species use olfactory (pheromonal) and tactile cues
- Terrestrial use visual and auditory cues
  - Semi-terrestrial fiddler crabs (*Uca* spp.) have elaborate courtship behavior
  - Also produce sounds by rapping propodus of cheliped against the substrate or by rapidly flexing walking legs

Mate Attraction

Decapod development

- With the exception of penaeid shrimps, all decapods brood their eggs on their pleopods
- Development times vary from several weeks to a year or more: larger eggs take longer to hatch
  - Biggest eggs hatch into large, lecithotrophic larvae—reproduction is year round in these species
  - Hatch for most shallow-water decapods is timed with the spring and summer plankton blooms.
    - Why?

Larval release often tied to tidal cycles (lunar cycles)- maximize transport from nearshore areas

Shaking of egg mass elicited by pheromone from eggs

Brachyura- all eggs usually hatched at same time (minutes to hours)

Anomura- some release over long period (weeks - month)

H. Januschke

penaeid	caridea	Brachyura	clawed lobster	crayfish	
nauplius	nauplius	nauplius	nauplius	nauplius	antennae and mandibles
protozoea	protozoea	protozoea	protozoea	protozoea	
zoea	zoea	zoea	zoea	zoea	exopods on maxillipeds
mysis	mysis		mysis	mysis	exopods on legs
megalops	megalops	megalops	megalops	megalops	pleopods
1st instar juvenile	1st instar juvenile	1st instar juvenile	1st instar juvenile	1st instar juvenile	
2nd instar etc.	2nd instar etc.	2nd instar etc.	2nd instar etc.	2nd instar etc.	

LOCOMOTION

N P Z M M ..

Never Play w/a Zebra Mussel's Mantle

Classification

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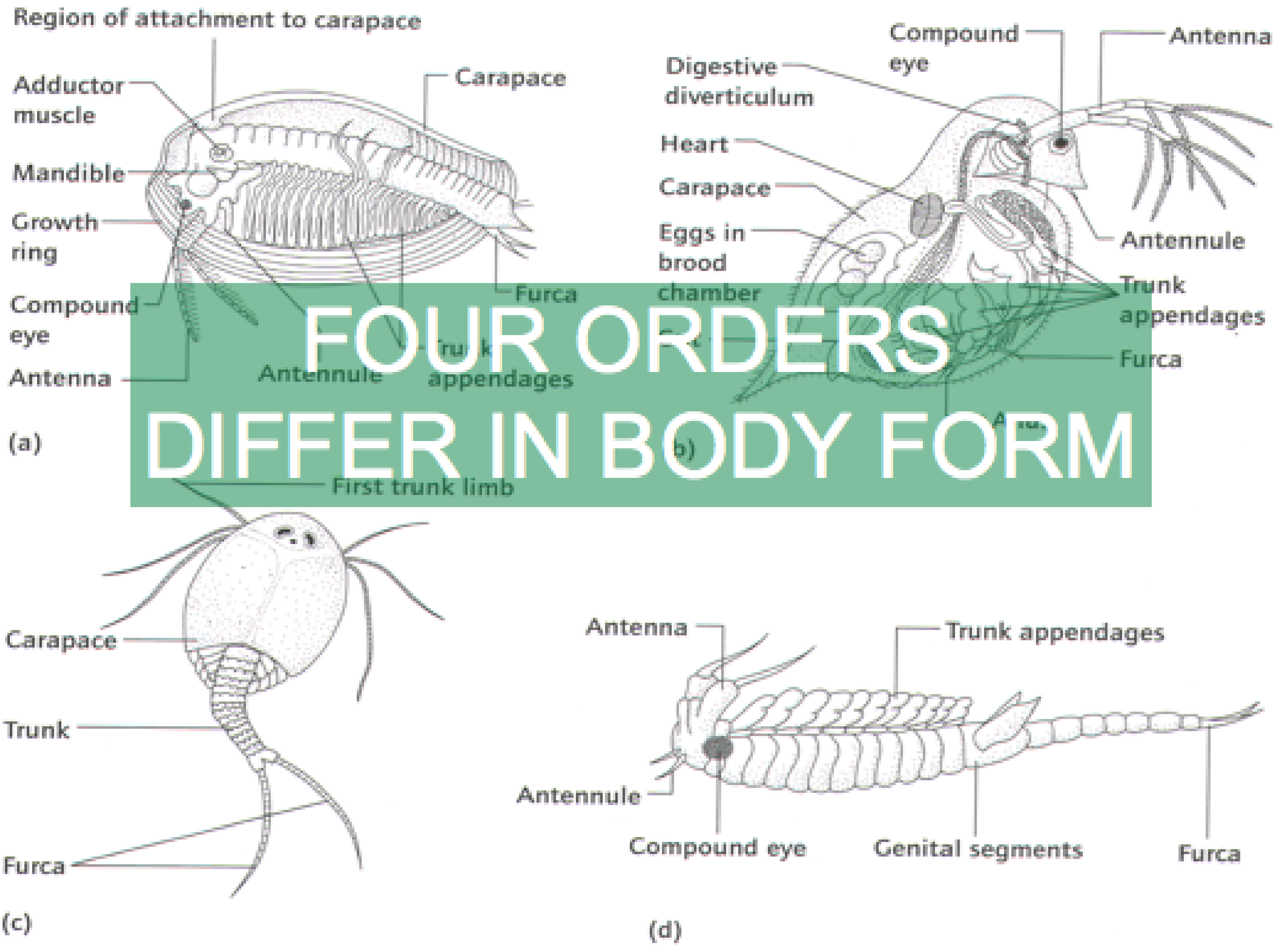
- Subclass Cirripedia—the barnacles

Subclass Branchiopoda

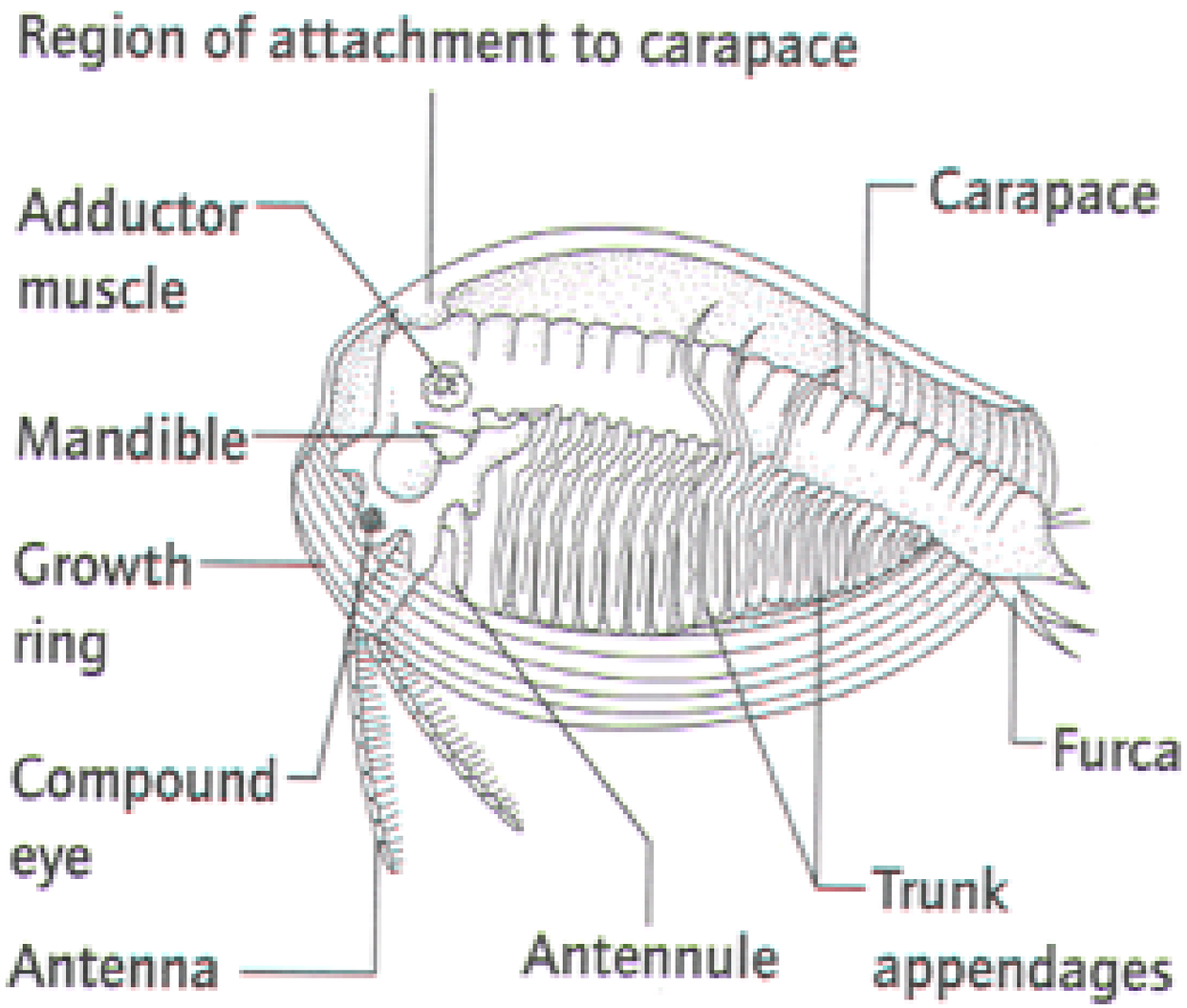
- Primarily Freshwater
- Coxa is modified to form flattened paddel
    - gas exchange / locomotion
- *branchio* - *poda*



FOUR ORDERS DIFFER IN BODY FORM

Branchiopoda

Conchostraca, lateral view with shell removed

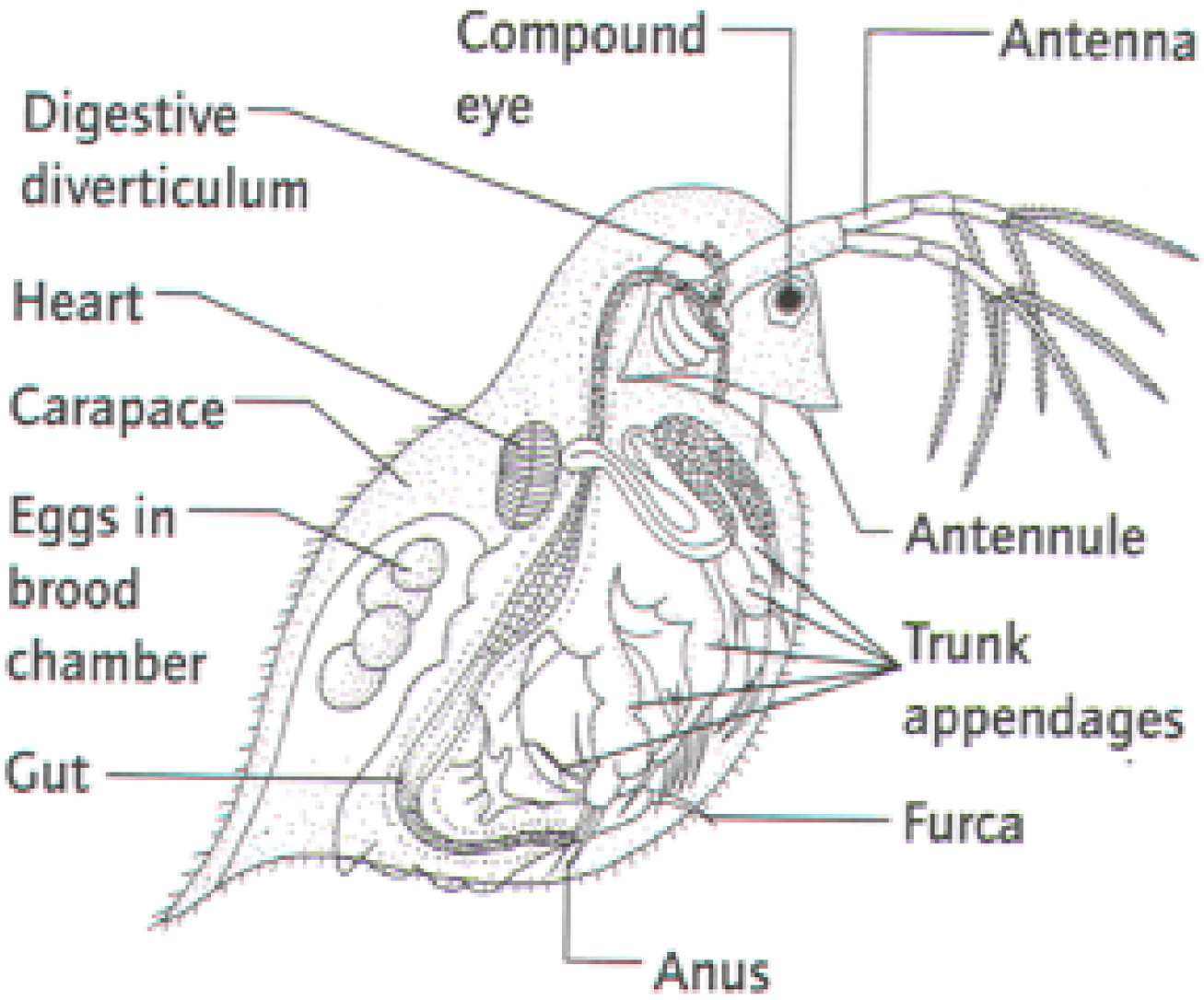


- Clam Shrimps
- Short, circular bodies
- Locomotory antennae
- Claw-like furca
- Dorsal brood chamber
- Laterally compressed carapace
- 30+ trunk segments
- Carapace encloses head
- Carapace not molted
- Grows by addition of concentric rings like….

Branchiopoda

Daphnia

Cladocera



- <u>Water Fleas</u>
- Short, circular bodies
- Locomotory antennae
- Claw-like furca
- Dorsal brood chamber
- Laterally compressed carapace
- Carapace never encloses head
- In some reduced to small dorsal brood chamber
- Not more than six pairs of trunk limbs

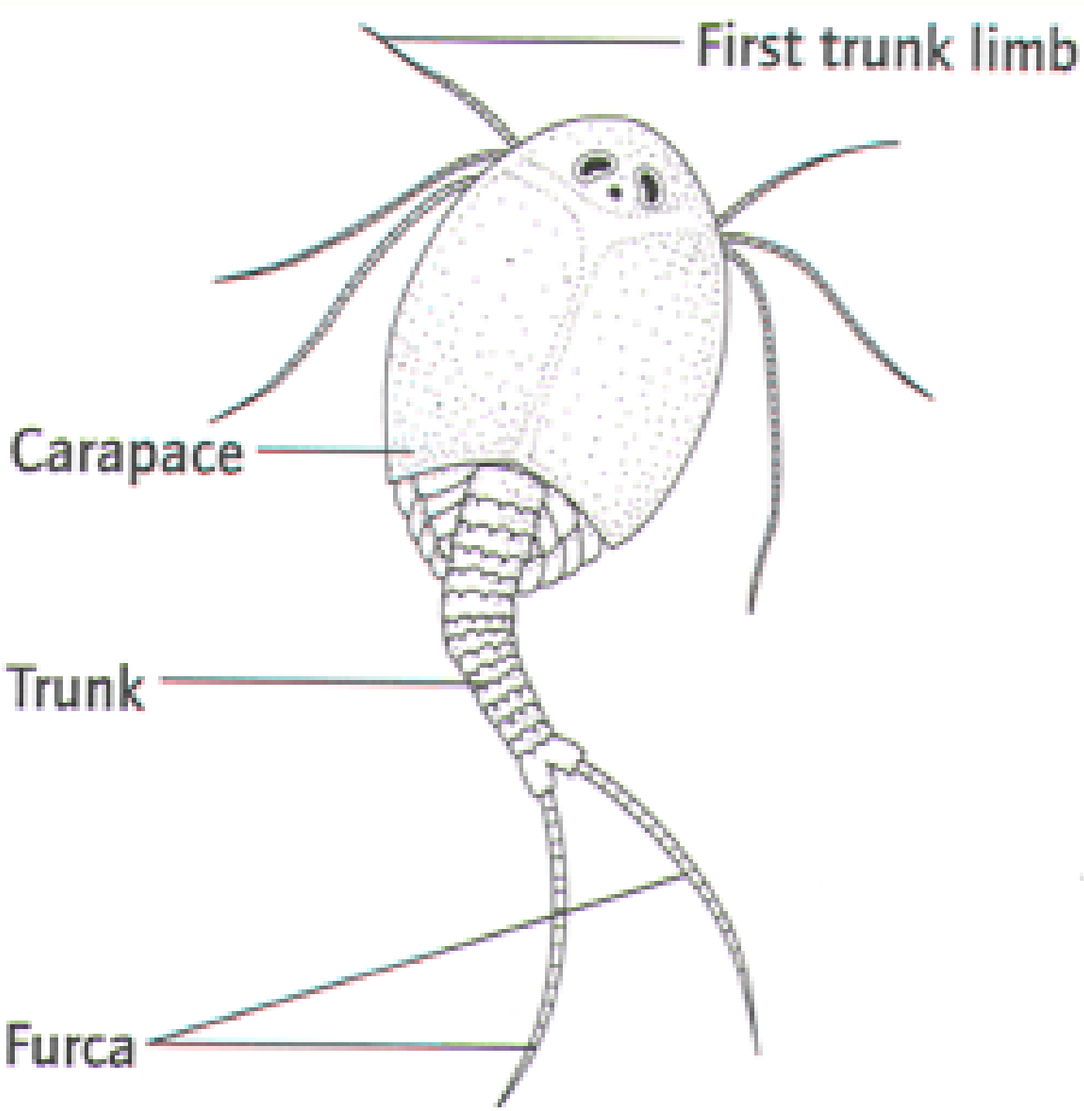
Branchiopoda

Daphnia

Cyclomorphosis

Branchiopoda

Notostraca

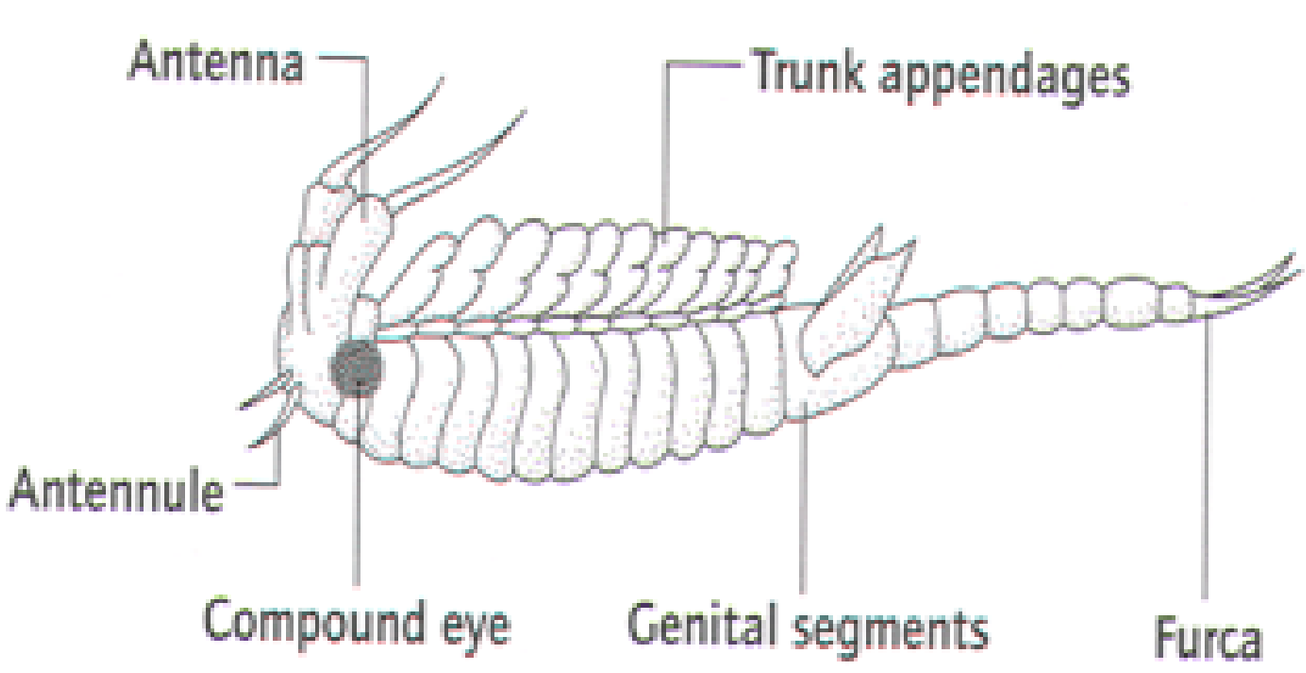


- <u>Tadpole Shrimps</u>
- Carapace wide and dorsoventrally flat
- 2 long annulate furcal rami
- Trunk segments partially differentiated,
- one section could have 6 pairs of limbs
- Up to 70 pairs of trunk limbs
- 11th carry brood chamber
- Harsh environments
- Extreme resting forms

Branchiopoda

Anostraca

- Brine or Fairy Shrimps
- Lack carapace
- Brood chamber in body
- Harsh environments
- Extreme resting forms

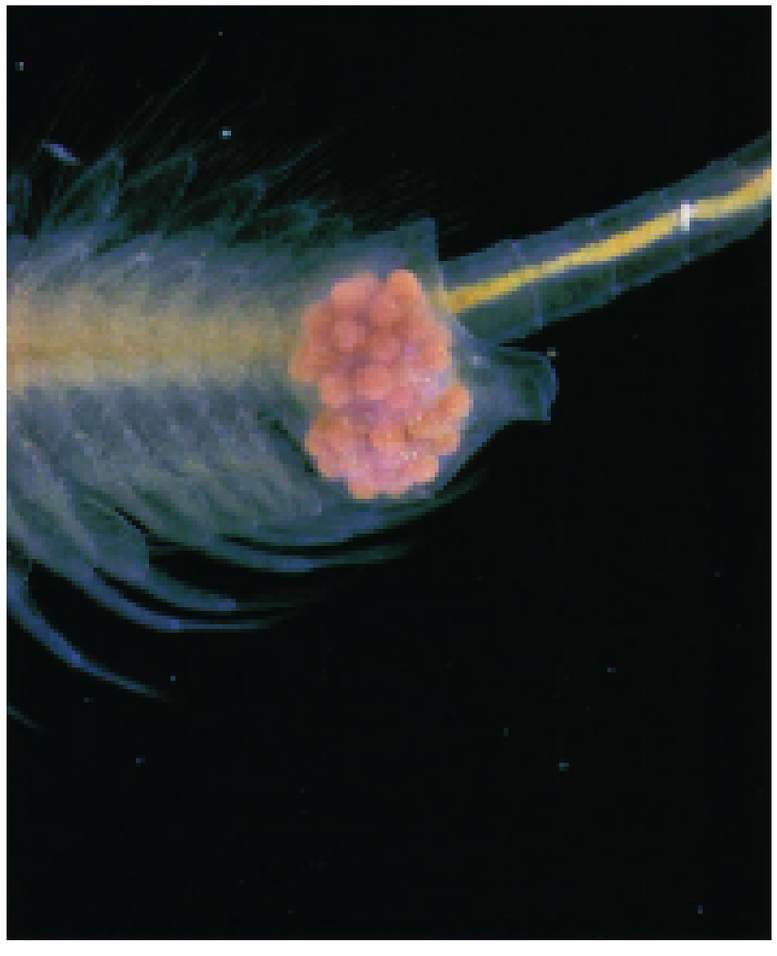


Can withstand drying, freezing, fish - birds - mammals

Sex and the Single Brine Shrimp

Around the Mediterranean, female brine shrimp have been reproducing—without help from males—for millions of years

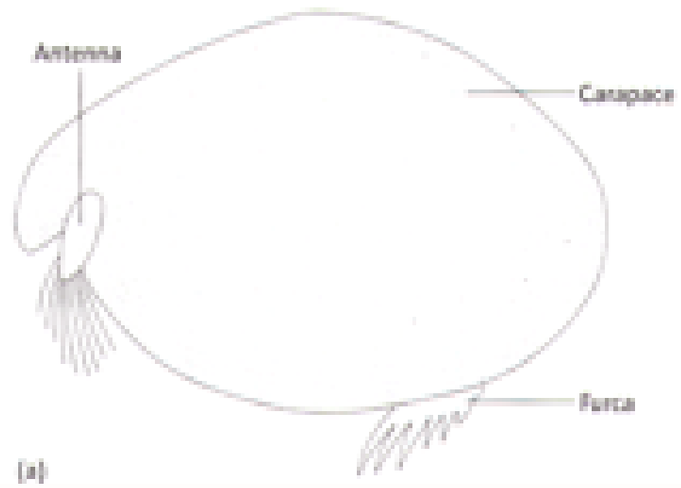
by Robert A. Browne

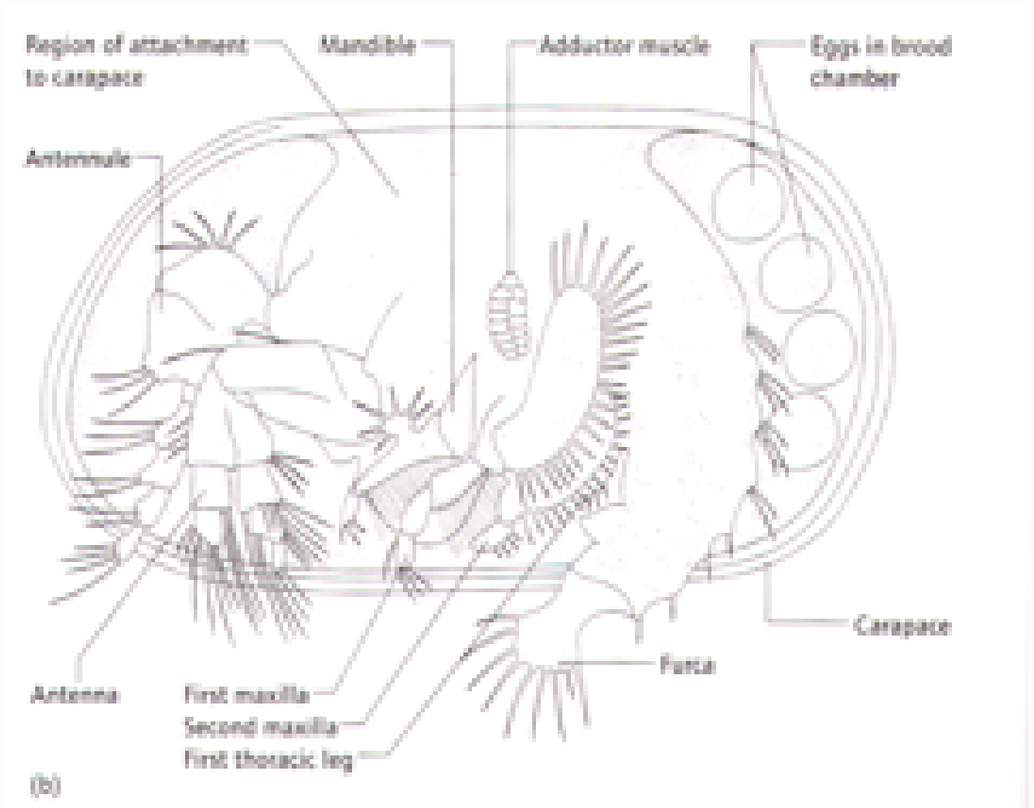


Subclass Ostracoda

- Head and body are enclosed in a bivalved carapace, lacking concentric rings
- Trunk of body possesses no more that 2 pairs of limbs

Subclass Ostracoda





- Short oval body
- Bivalved, often calcarous shell from by carapace

- Molting does occur
- No segmentation evident

Subclass Ostracoda

Reproduction

- Some FW - parthenogetic
- External genitalia and gonopores are ventral
- Zenker's organ
  - Peristalic sperm pump
- Largest Sperm
  - Larger than organism?

- Male clasps female dorsally and posteriorly with 2nd antennae or 1st thoracopods

Subclass Ostracoda

Reproduction

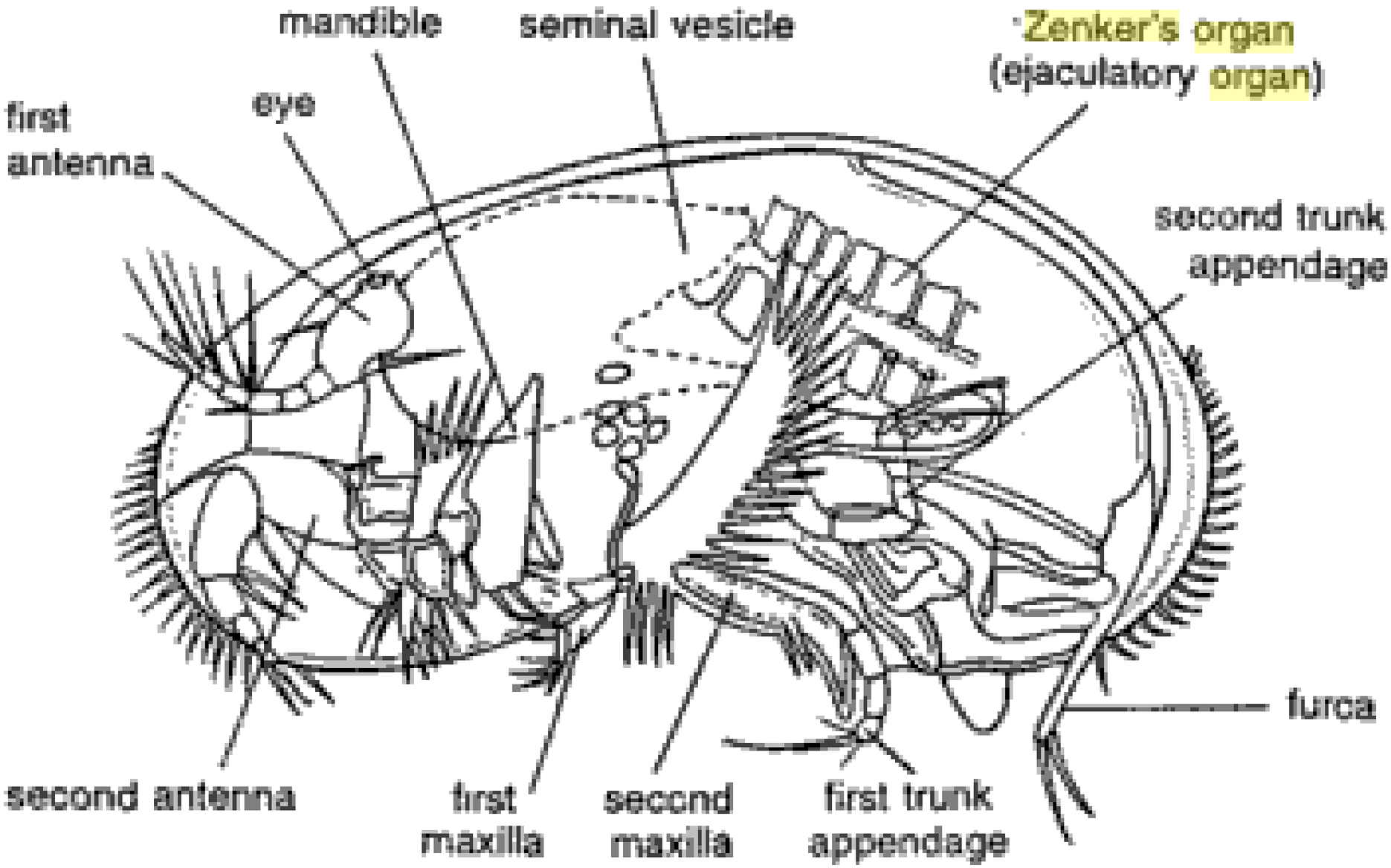


Fig. 34.5 *Candona suburbana.*

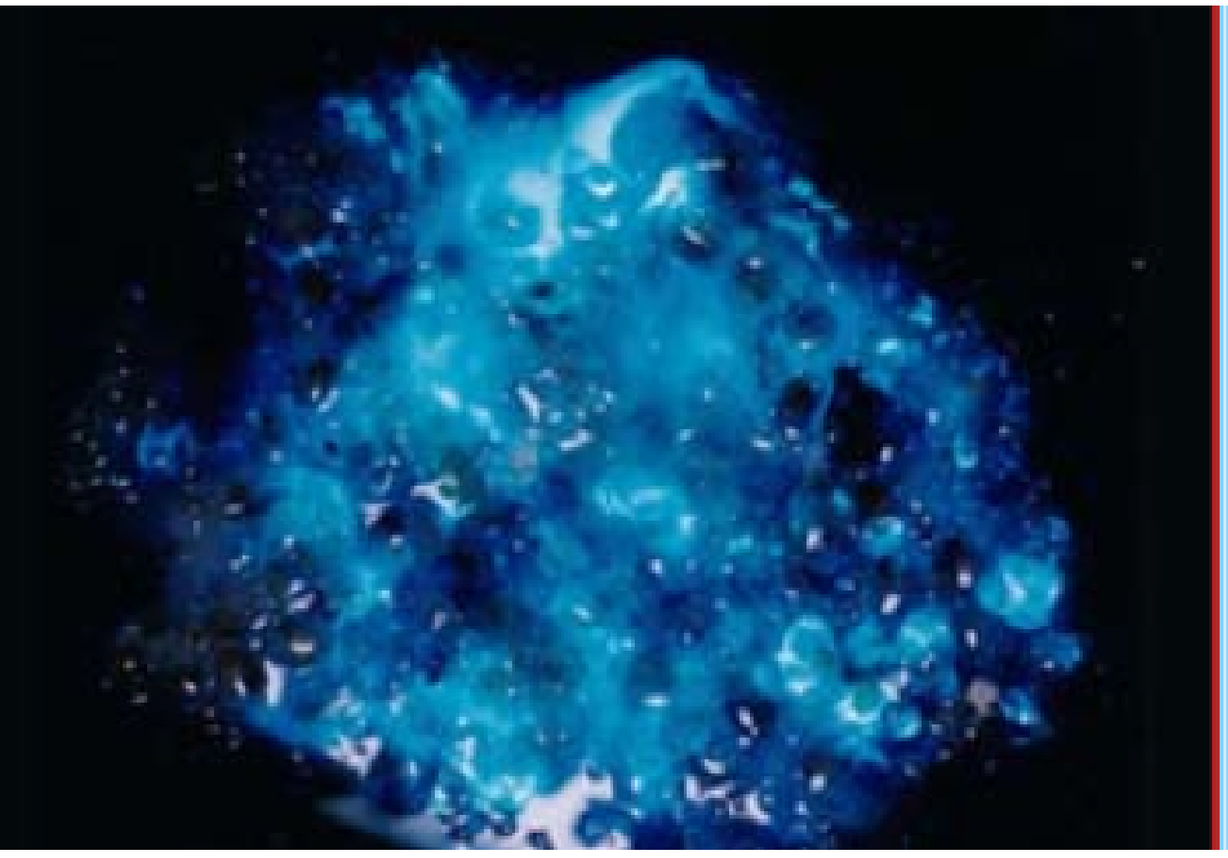
Subclass Ostracoda

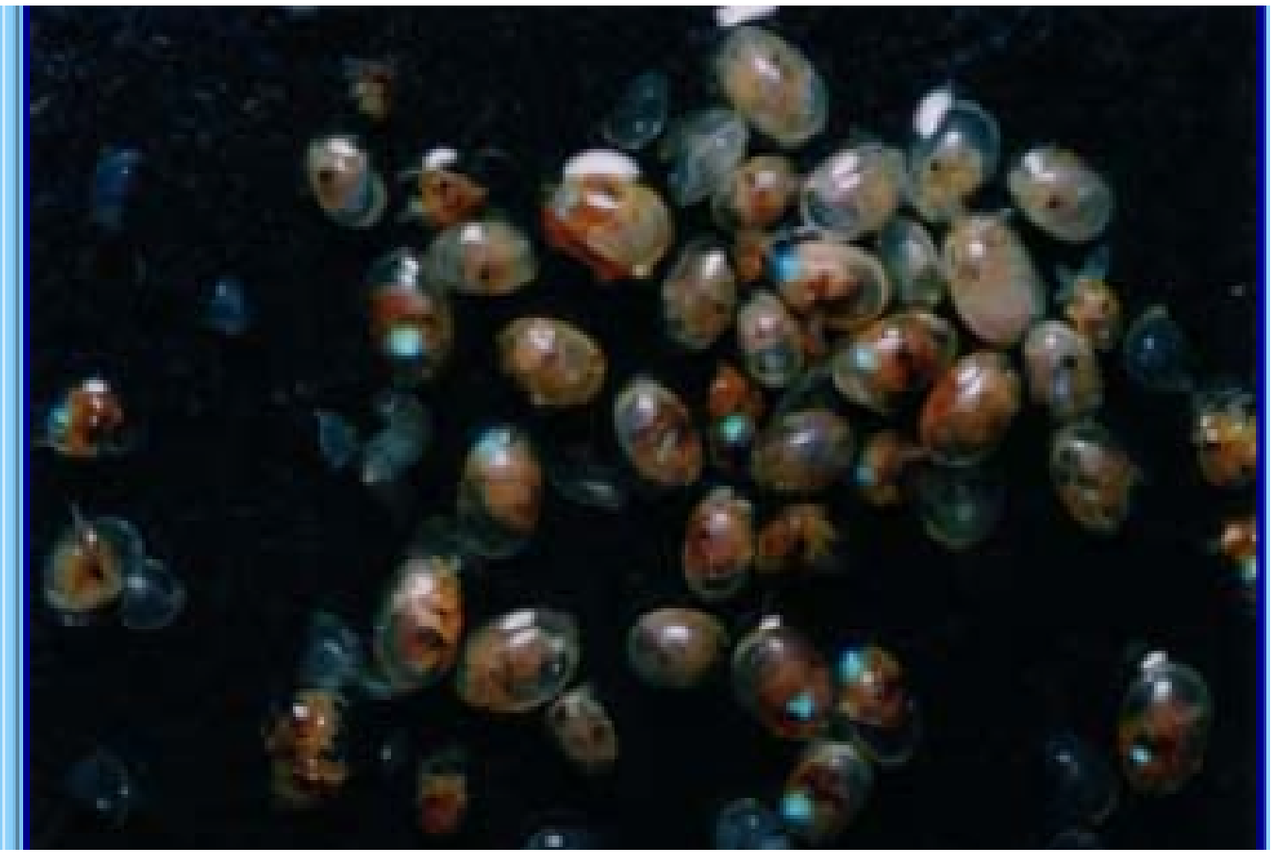
Deep-sea

Gigantocypris mulleri

Subclass Ostracoda

Reproduction





Subclass Ostracoda

Giant sperm found in crustacean fossils

‘Gargantuan gametes’ are oldest on record and have visible nuclei.

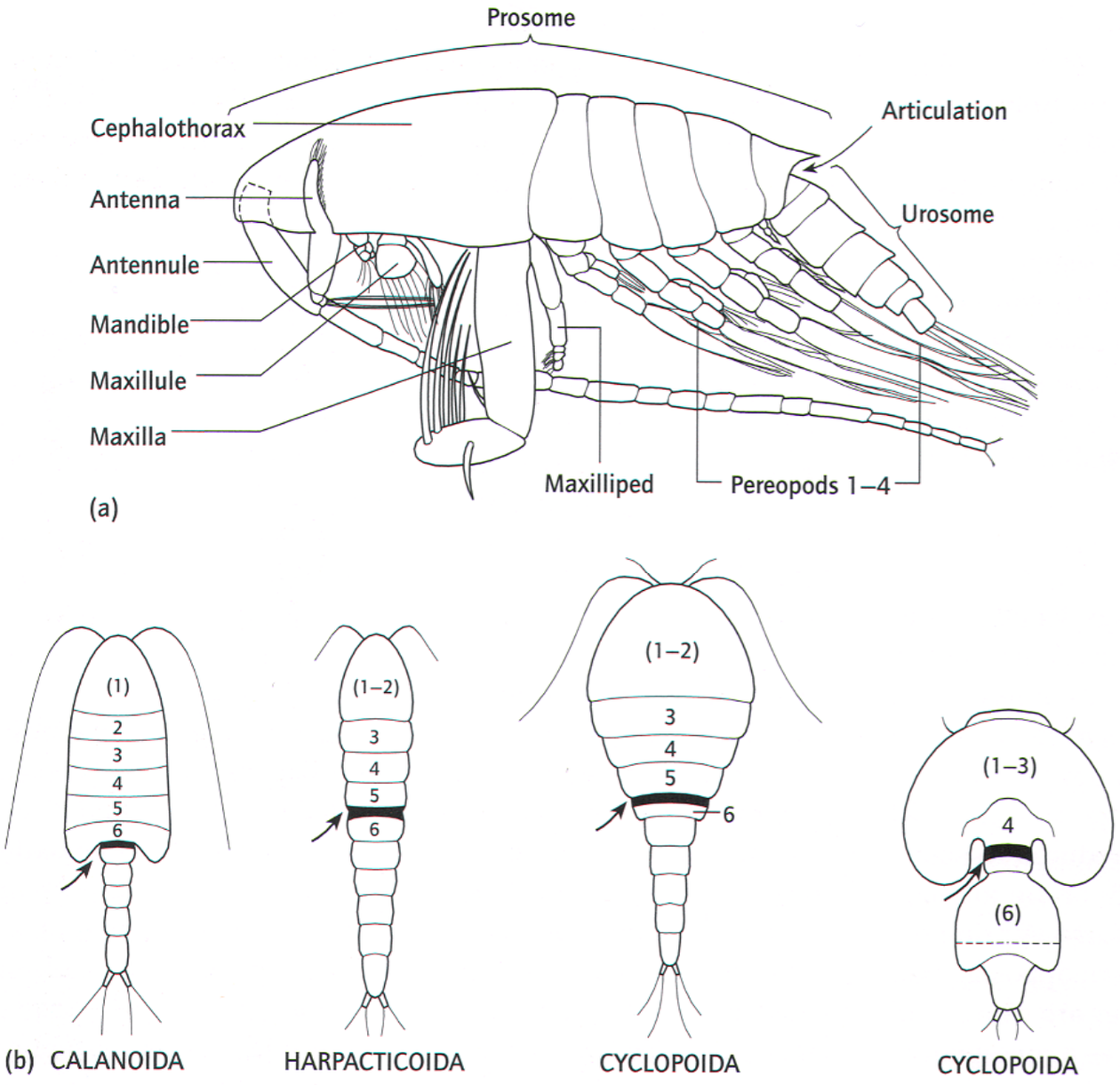
Daniel Cressey

14 May 2014

Subclass Copepoda

- Thorax with 6 segments, abdomen with 5 segments
- First segment of thorax fused to head
- Loss of all abdominal appendages
- Most species bear a single, "naupliar" eye

Subclass Copepoda



- Dominant member of plankton
- 25% parasitic
- Body parts
  - Head with well developed mouth parts and antenna
  - Segmented (6) thorax w/ limbs
- Dramatic diversity
  - Parasitic forms lose segmentation
- Lack carapace and compound eyes
- Eggs

November
December
January
February
March
April
May
June
July
August
September
October
November

Depth (m)
0
100
200
300
400

C5 Grazing

Hatch and Develop (N1-N6, C1-C4)

Overwinter as C5

C5 Emerge – Molt to Adults – Reproduce

C5 Overwinter

Subclass Pentastomida

- All are parasitic in the nasal passages of vertebrate hosts
- body bears only 2 pairs of appendages, with claws

Subclass Pentastomida


An x-ray reveals tiny, cashew-shaped calcified cysts. From Despommier et al

Management and Therapy:

Pentastomiasis is only treated when it becomes a serious medical condition. In these cases, s

Epidemiology:

Pentastomiasis is found mostly in tropical and subtropical areas. It's been reported relatively typically found in West Africa, where it infects the respiratory tracts of pythons and other re certain parts of Europe. Infections have also been reported in the Americas (Drabek 1089).

Public Health and Prevention Strategies:

Improved sanitation and food sterilization techniques will limit the spread of Pentastomiasis people to the risks of eating uncooked foods and handling wild reptiles.

Useful Web Links:

A case study in Chicago, from Applied Radiology Online

2 photographs (1 2) of encysted larvae, from the Bristol Biomedical Image Archive.

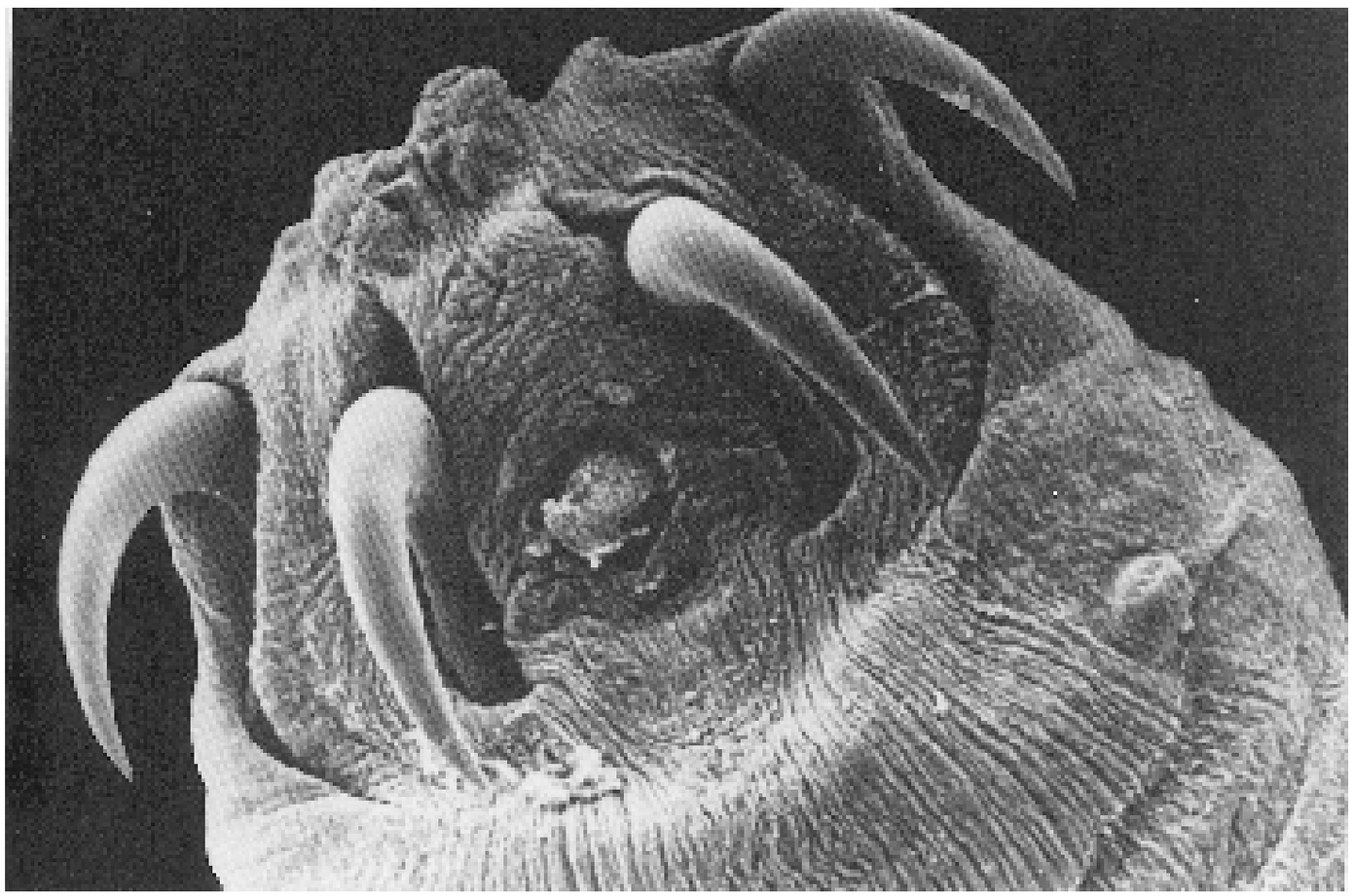
A page about reptile parasites for concerned owners

A page of links to helpful parasite information

References:

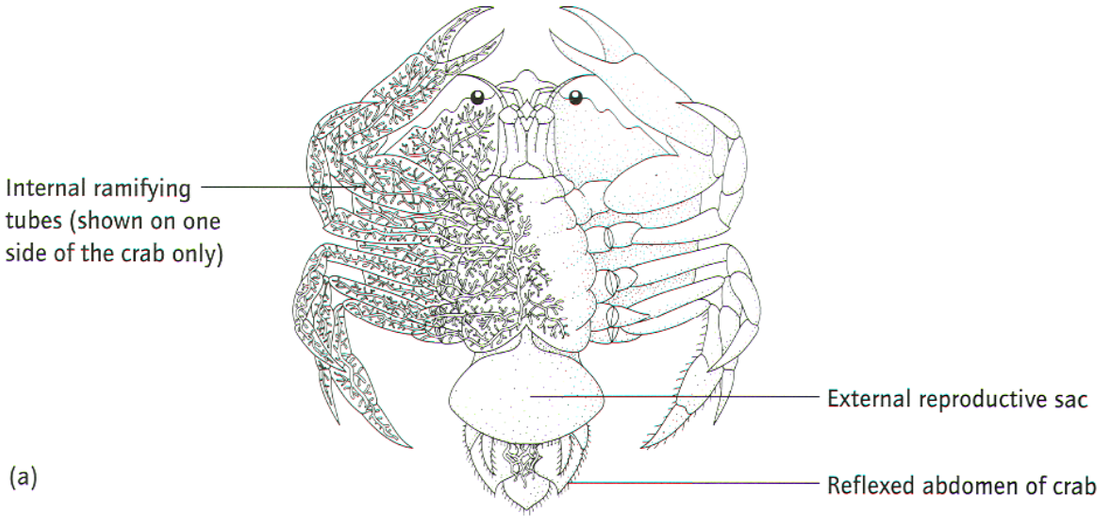
1. Cannon, D. A. "Linguatid Infestation of Man." *Annals of Tropical Medicine*, Vol. 36, No. 4,

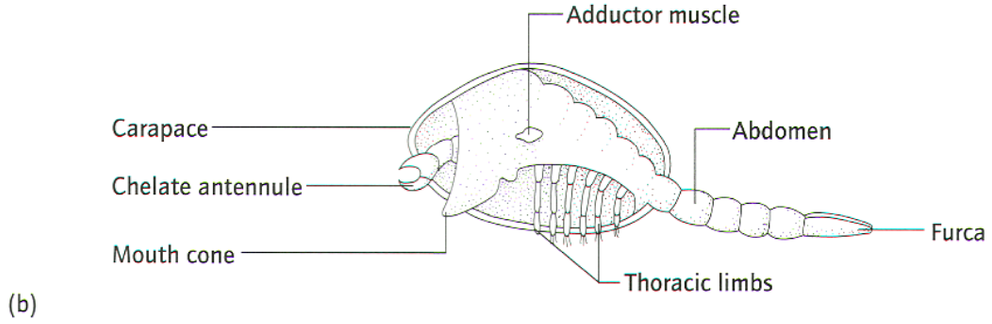
2. Despommier, Dickson D., Gwadz, Robert W., Hotez, Peter J. *Parasitic Diseases, 3rd ed.* Sp

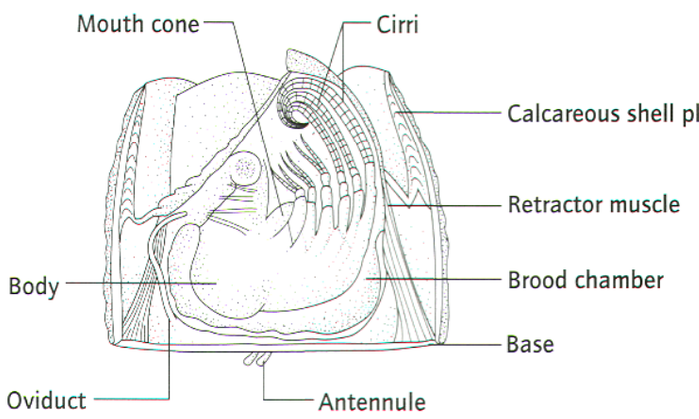


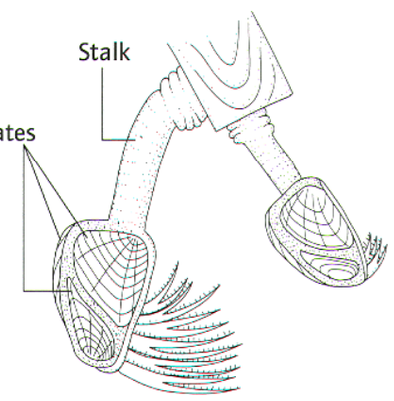
http://www.stanford.edu/class/humbio103/ParaSites2001/pentastomiasis/Erica%20parawebsite.html

Subclass Cirripedia









- Highly modified
  - Sessile or Parasites
- Headless
- Lack abdomen
- Little / No segmentation

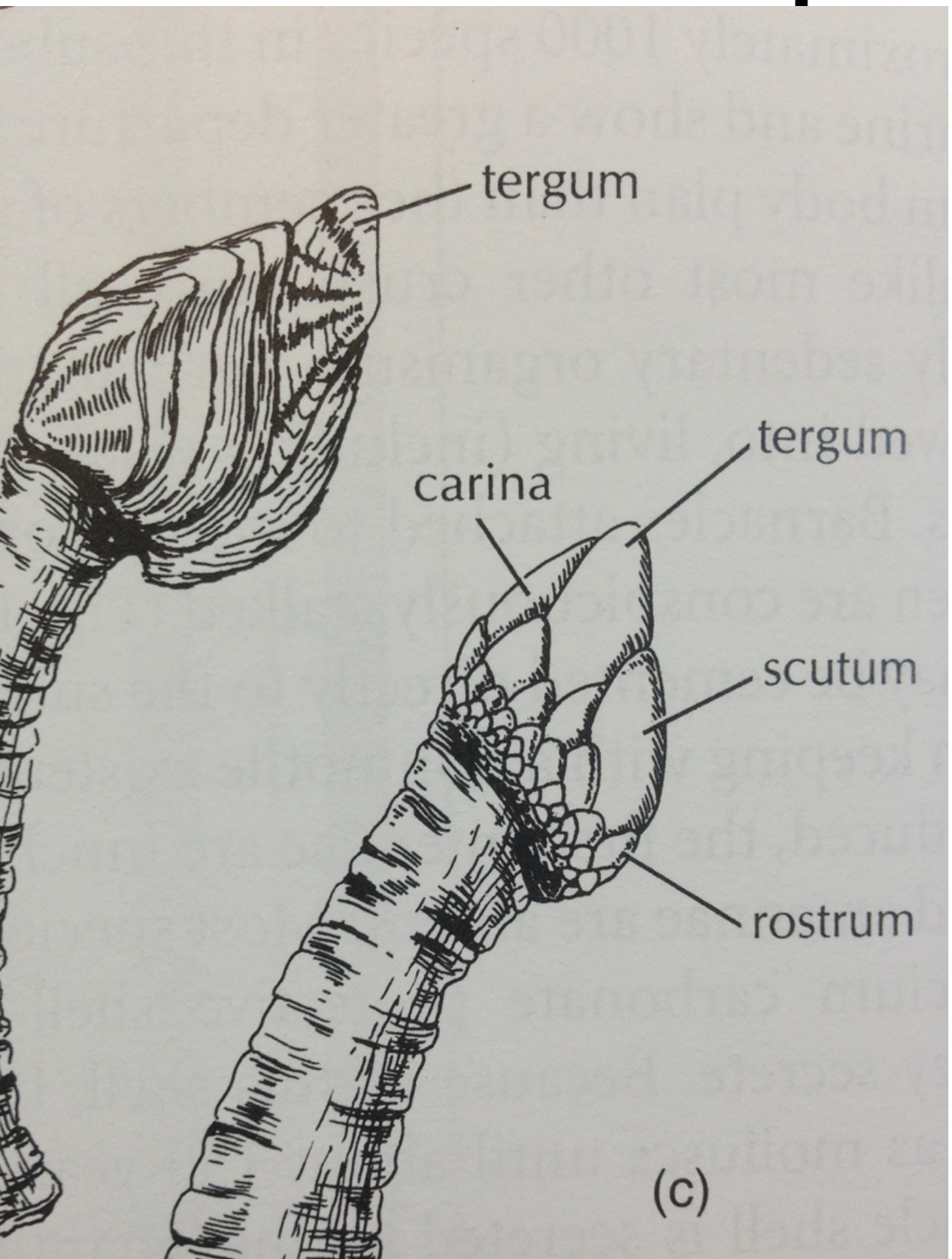
- Rhizocephala

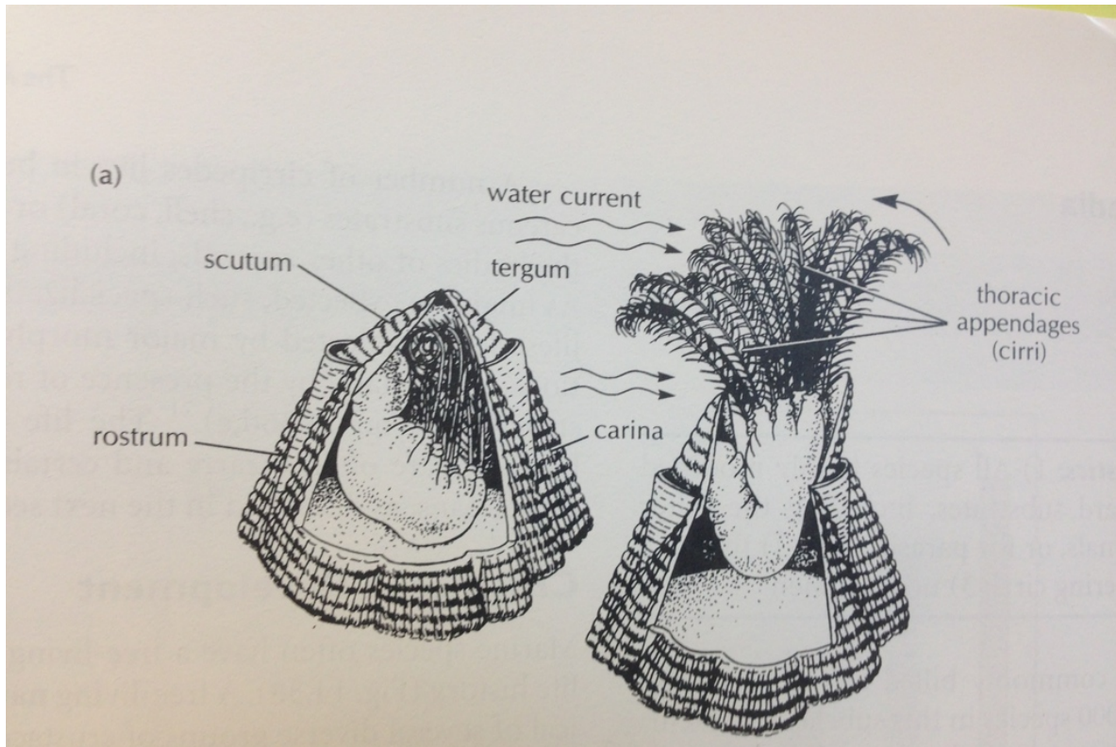
- Ascothoracica
  - Some chelate antennule
  - 6 pairs of swimming legs
  - Carapace

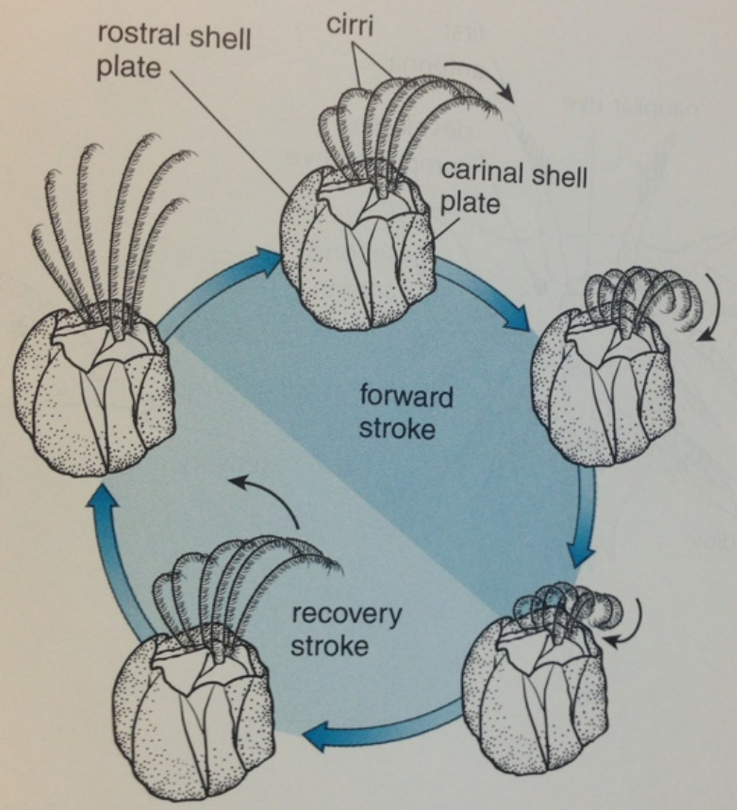
- Thoracica TRUE
  - “legs” becoming cirri
  - Reinforced carapace, calcareous

- Acrothoracica
  - Like barnacles w/o plates

Subclass Cirripedia





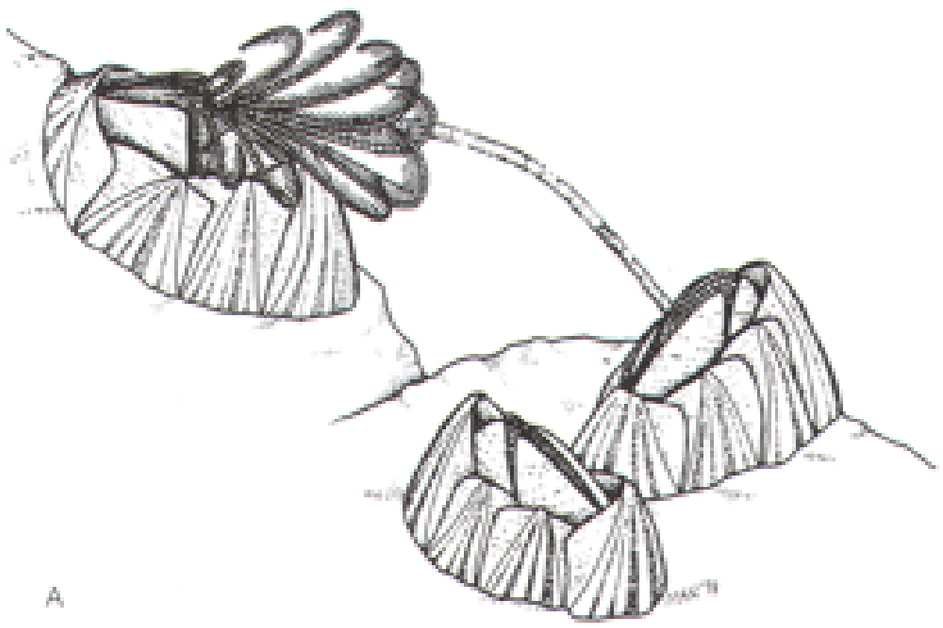


Subclass Cirripedia

Subclass Cirripedia

Reproduction

- Many hermaphrodites
- External fertilization
  - Mantle cavity
- Some broadcast spawn




MarLIN
The Marine Life Information Network for Britain & Ireland
Image: Sue Scott

Tanner or snow crab
Chionoecetes

Hardshell and softshell mating

Only morphologically mature males can mate with hardshell females

Female mound

Tidal phasing of larval launch pads?

BRADLEY G. STEVENS & JAN A. HAAGA
National Marine Fisheries Service, Kodiak Laboratory, Kodiak, USA

WILLIAM E. DONALDSON
Alaska Dept. of Fish and Game, Kodiak, USA

ABSTRACT

Female Tanner crabs, *Chionoecetes bairdi*, aggregate and form mounds at a deepwater (150 m) site in the spring (Stevens et al. 1994). This paper reviews observations of crab behavior, which were made each spring for 6 years (1991-1995, and 1998), via submersible, ROV, and/or video camera sled in Chiniak Bay, Alaska. Timing of mound formation was compared to water temperature, lunar cycle, tidal exchange, storm frequency, and Secchi disk depth. Mound formation was observed in 3 years (1991, 1994, and 1995) within 0-4 days of the maximum spring tide; no other environmental indicator was coincident. Crabs captured from mounds (1991, 1995) were observed releasing larvae in tanks or buckets, whereas crabs captured prior to mound formation (1995) or afterwards (1992, 1998) were not releasing larvae. Based on these data, we hypothesize that mound formation is triggered by tidal rhythms associated with the highest spring tide in April or May, coincides with larval release, and functions to improve larval dispersal by elevating spawners above the bottom sediments.