

Lecture Crustacea_partB

Adaptive Diversification

- Crustaceans are unquestionably the dominant arthropod in marine environments.
- They also share dominance in freshwater environments with the insects.
- The class Malacostraca is most diverse and members of Copepoda are most abundant.

Crustaceans

Branchiopoda

Maxillopoda

Ostracoda

Malacostraca



Brine shrimp



Copepod



Barnacles



Ostracod



Crayfish



Sand hopper



Crab



Prawn



Mantis Shrimp



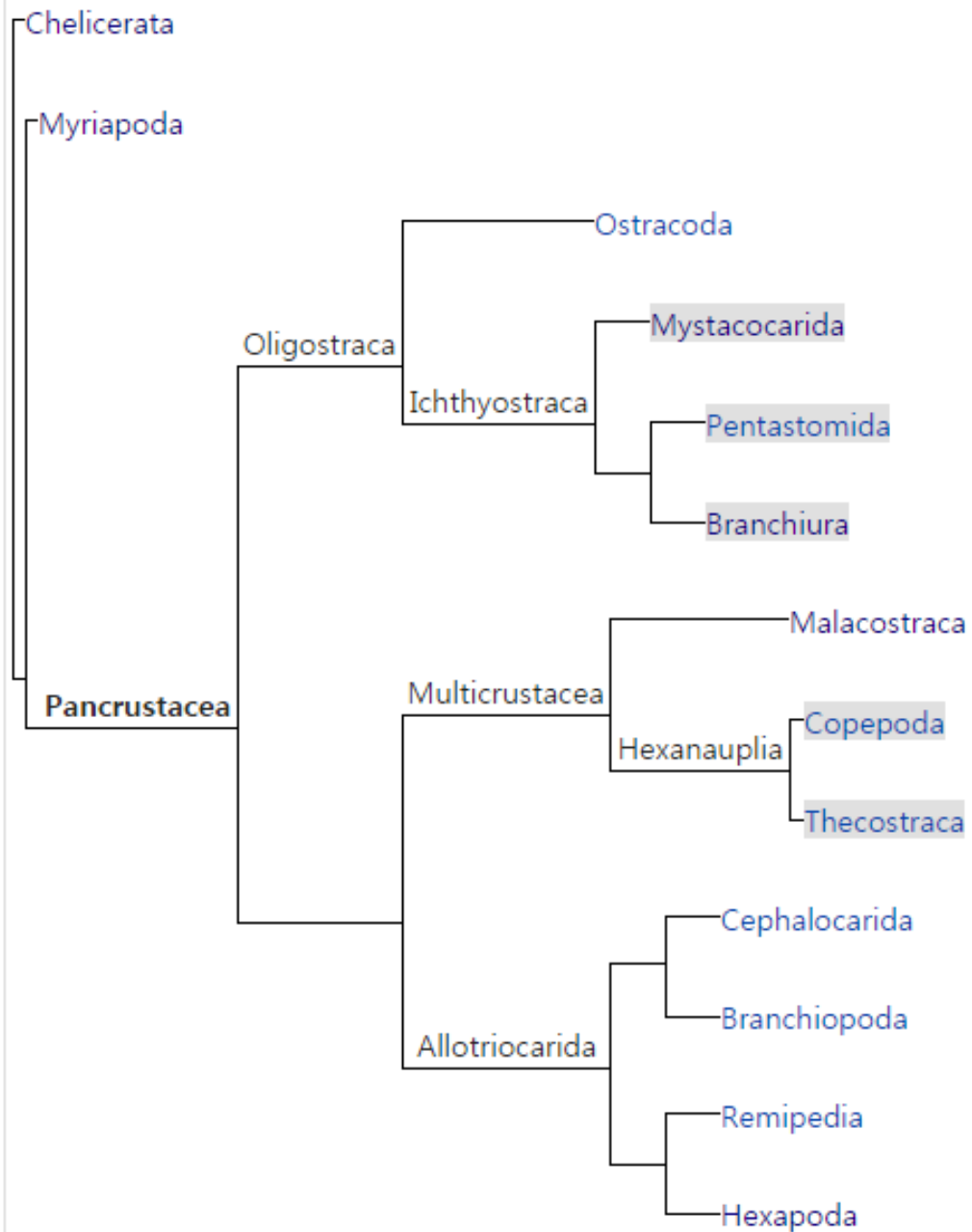
Krill

Prawn versus shrimp

Although prawns are sometimes defined as large freshwater shrimp.

Shrimp and prawn are common names without the formal definition that scientific terms provide.

They are terms of convenience with little circumscriptional significance, and do not represent actual taxa



Cladogram following Oakley *et al.* (2013)^[14]

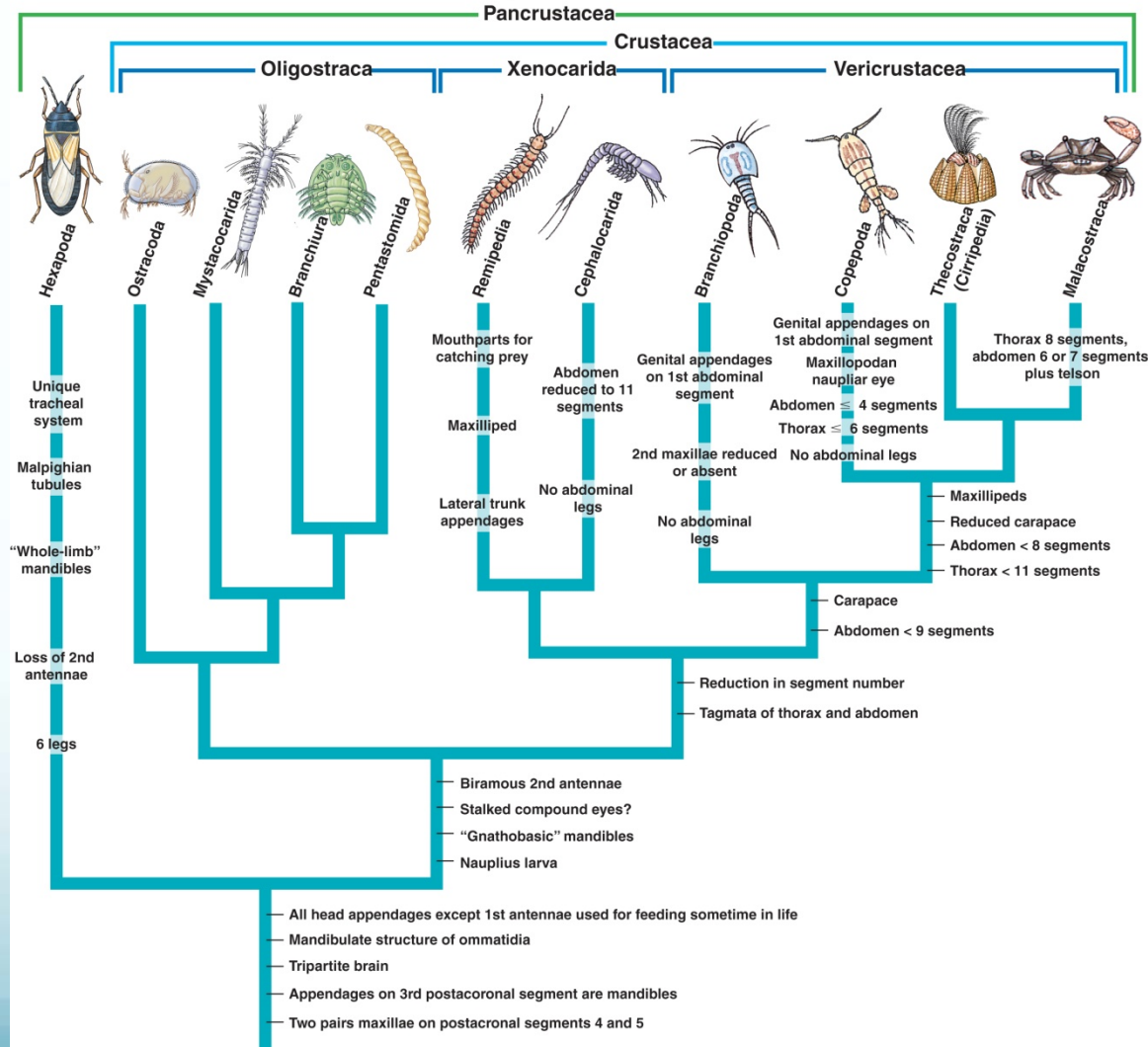
Subphylum Crustacea - Appendages

- Members of Malacostraca and Remipedia have appendages on each somite (segment).
 - Other classes may not bear appendages on abdominal somites.

Oligostraca

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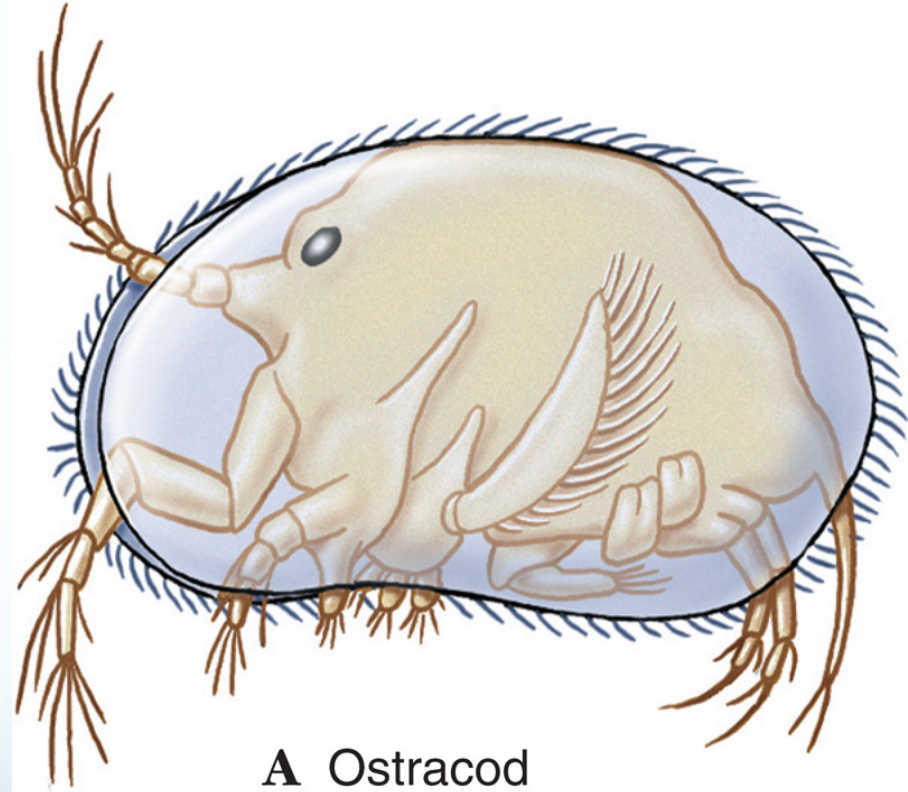
- Clade Oligostraca includes
 - Mystacocarida
 - Ostracoda
 - Branchiura
 - Pentastomida



Class Ostracoda

- **Ostracods** are enclosed in a two part carapace and look a bit like a clam.
- Marine or freshwater.
- Mostly benthic.

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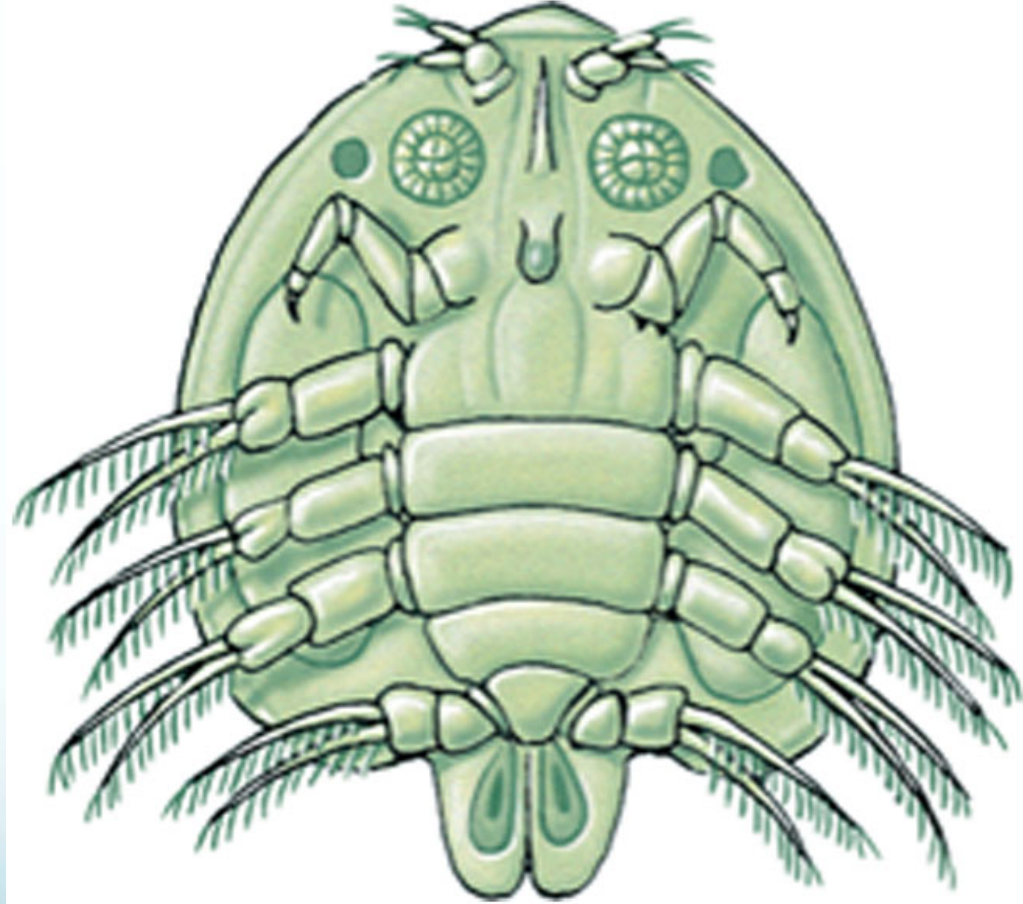


A Ostracod

Class Maxillopoda – Subclass Branchiura

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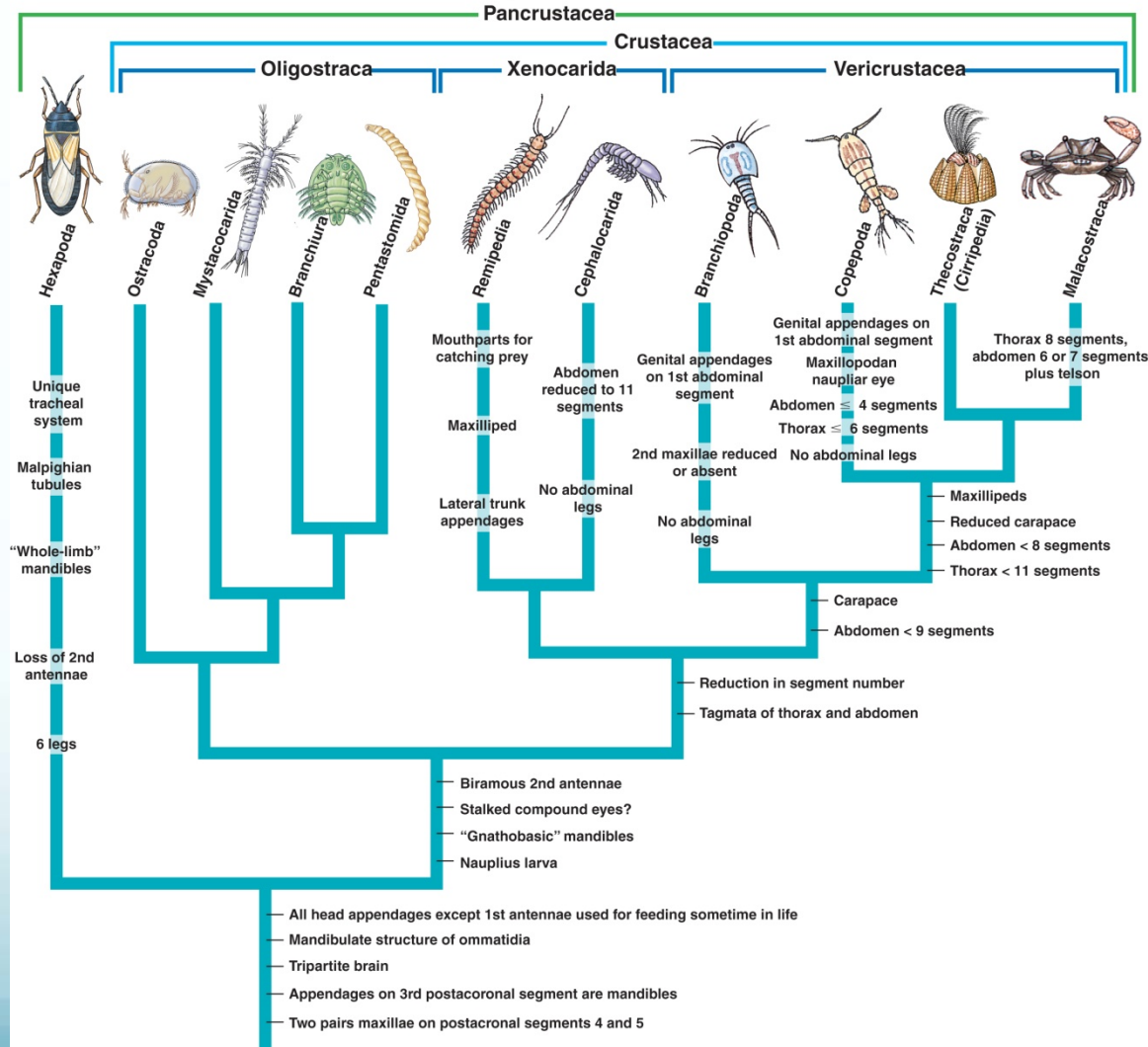
- Members of the subclass Branchiura lack gills.
- Most are ectoparasites of marine and freshwater fish.
- 5–10 mm long.
- Development is direct.



Xenocarida

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- Clade Xenocarida includes
- Remipedia
- Cephalocarida



Class Remipedia

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- Only 10 described species in **Class Remipedia**.
- All found in caves connected to the sea.
- Primitive features include 25–38 segments with similar, paired, biramous, swimming appendages.
- Antennules also biramous.
- Maxillae and maxillipeds are prehensile and specialized for feeding.
- Swimming legs are directed laterally rather than ventrally as is found in copepods and cephalocarids.

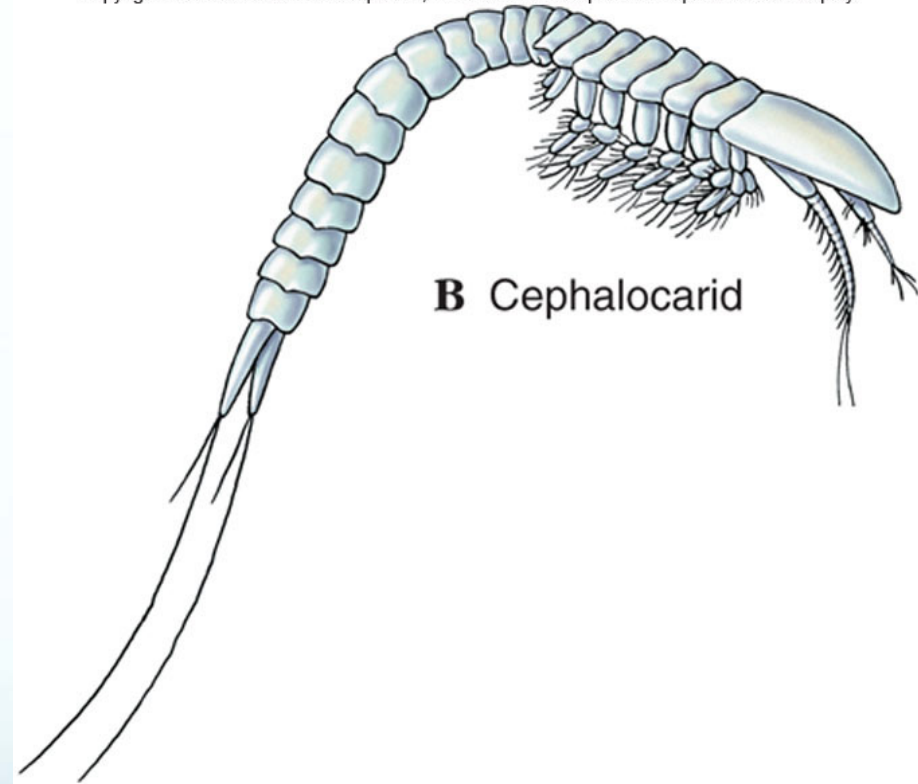
A Remipede



Class Cephalocarida

- Only 9 species described in **Class Cephalocarida**.
- Live in coastal bottom sediments from intertidal zones to 300 meters depth.
- Thoracic limbs and 2nd maxillae are very similar.
- Lack eyes, a carapace, and abdominal appendages.
- True hermaphrodites and unique in discharging eggs and sperm through same duct.
- Detritivores

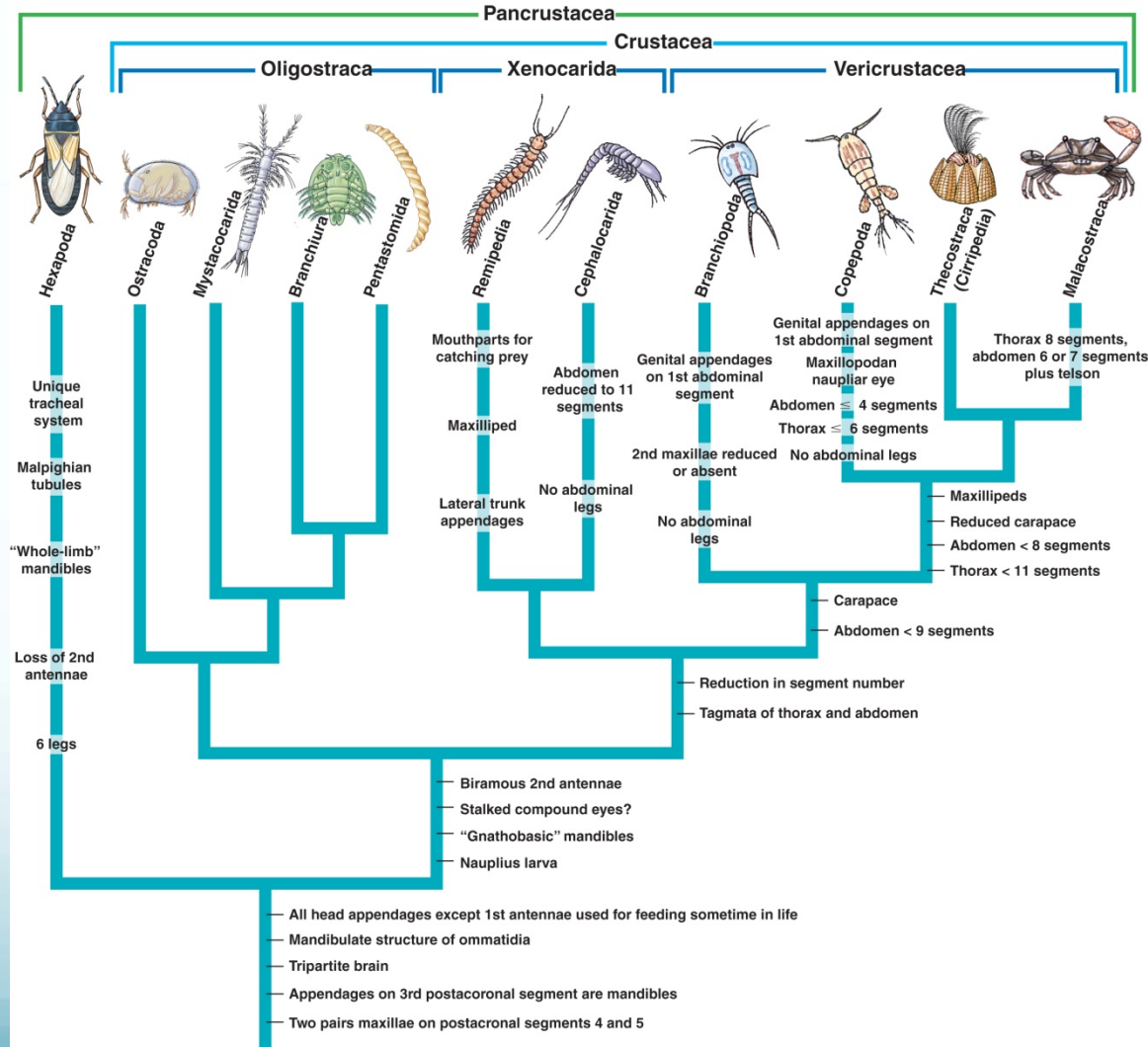
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Vericrustacea

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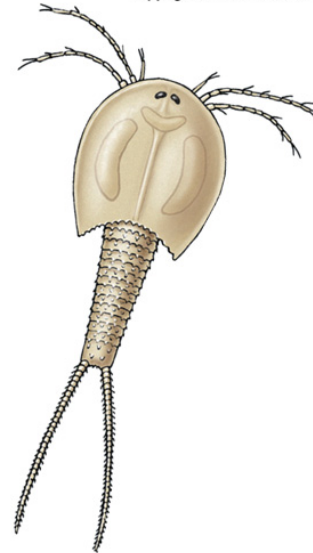
- Clade Vericrustacea includes
 - Branchiopoda
 - Copepoda
 - Thecostraca
 - Malacostraca



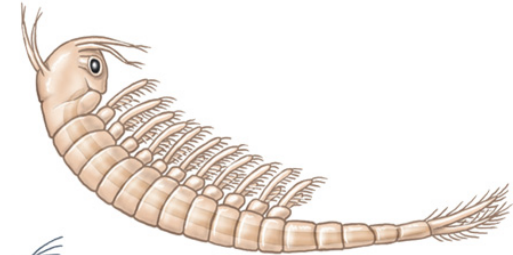
Class Branchiopoda

- Members of the Branchiopoda are unified by the **presence of gills on many of the animals' appendages**, including some of the mouthparts. This is also responsible for the name of the group (from the Greek: **branchia, gills**)
- Includes three orders:
 - **Anostraca** – fairy shrimp and brine shrimp, no carapace.
 - **Notostraca** – tadpole shrimp, carapace forms a large dorsal shield.
 - **Diplostraca** – water fleas – carapace encloses body but not head.

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A Tadpole shrimp
(order Notostraca)



B Fairy shrimp
(order Anostraca)



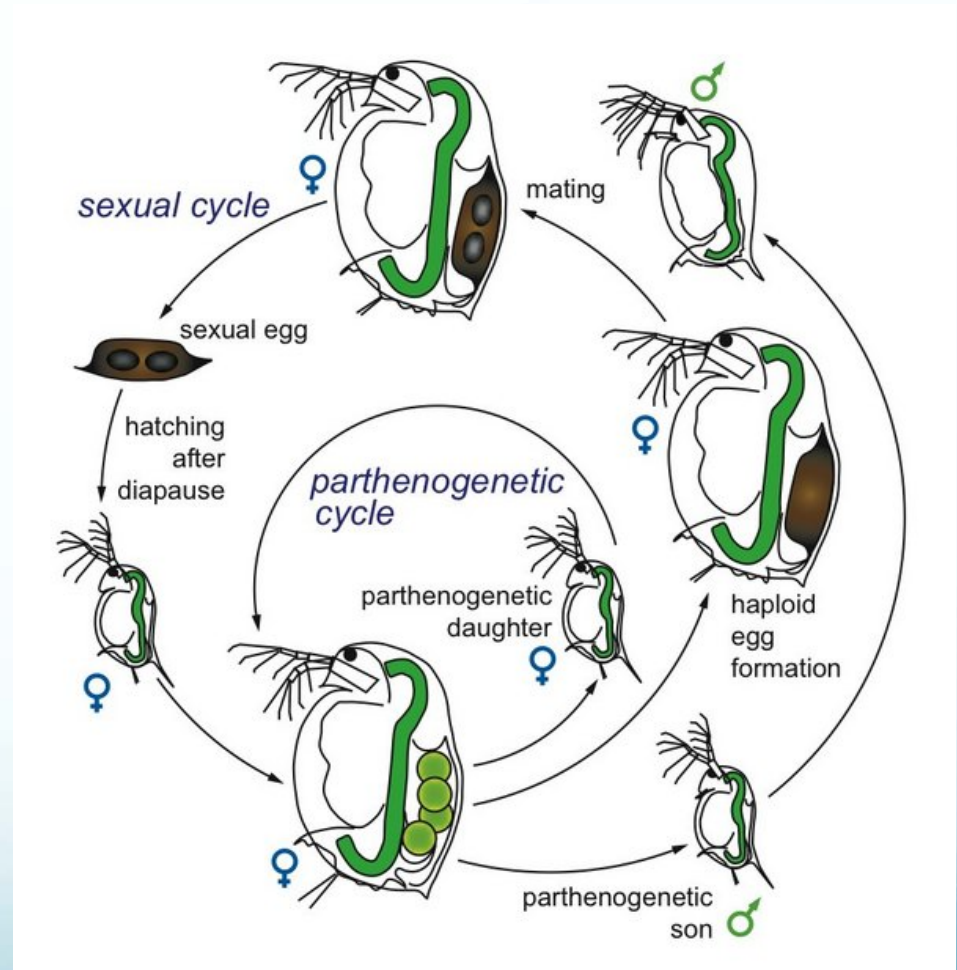
C *Daphnia*
(order Diplostraca,
suborder Cladocera)

Class Branchiopoda

- **Phyllopodia** – legs that serve as respiratory organs.
 - Legs may be used for filter feeding and locomotion as well.
 - (have ventral phyllopodia - “leaf-like appendages” - for respiration)
- Mostly freshwater forms.

Class Branchiopoda

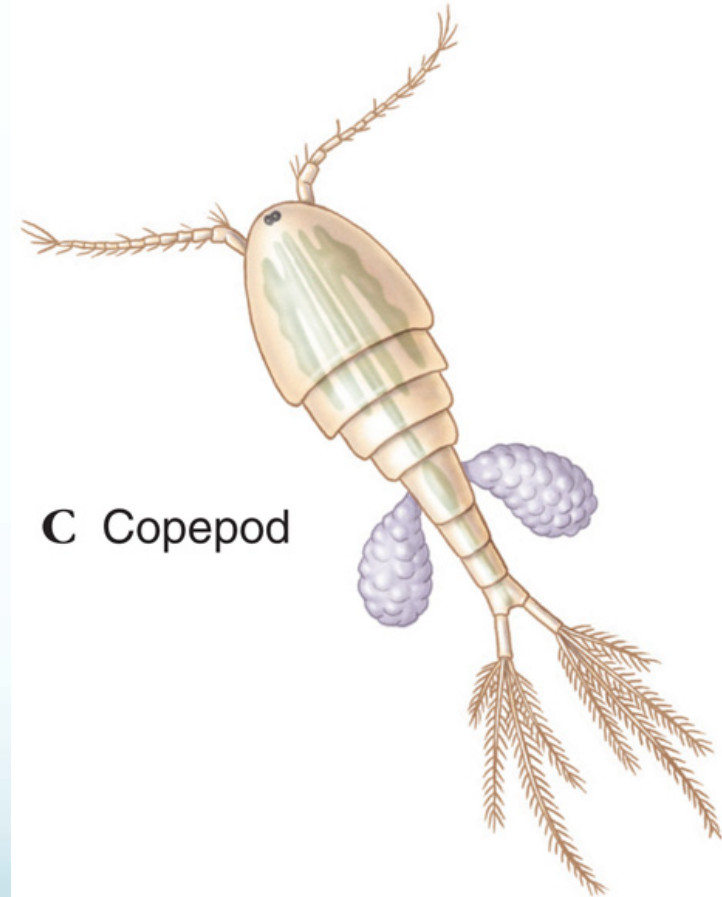
- Water fleas (like *Daphnia*) produce females parthenogenetically in summer. Males are produced when unfavorable conditions arise and overwintering fertilized eggs are produced that are resistant to cold and desiccation.



Class Copepoda

- Planktonic crustaceans include many species of **copepods** which are among the most numerous of all animals.
 - They lack a carapace.
 - Retain the simple **maxillopodan eye** in adults.
 - Antennules used in swimming.
 - Very diverse.

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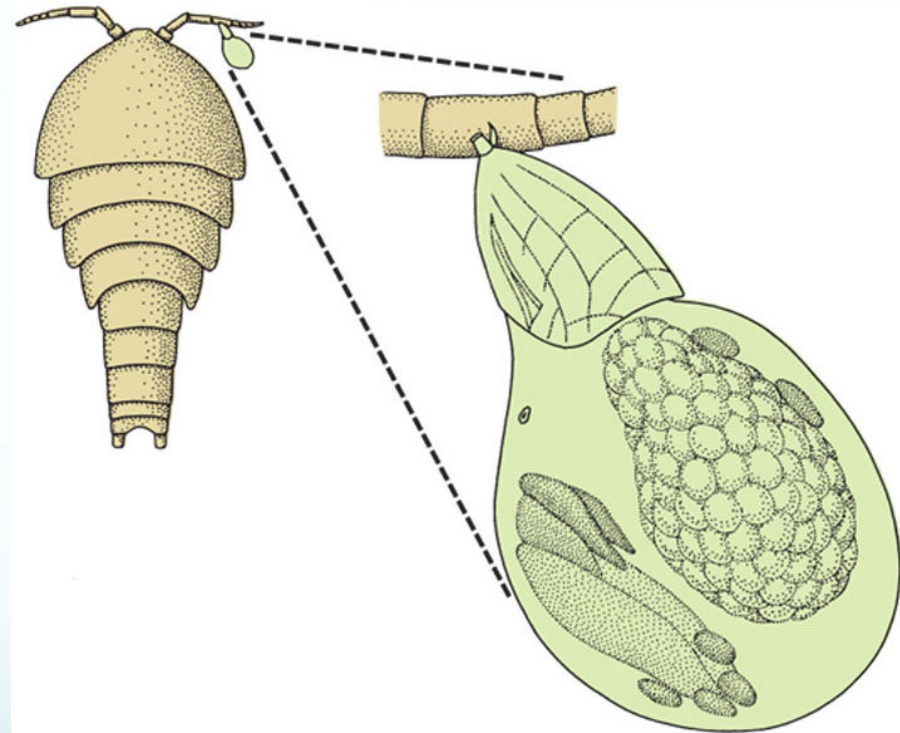
C Copepod

Class Copepoda

- Parasitic forms highly modified and reduced - often unrecognizable as arthropods.
- Free-living copepods may be the dominant consumer.
- Marine copepod *Calanus* is most abundant organism in zooplankton by biomass.
- *Cyclops* and *Diaptomus* important elements of freshwater plankton.
- Some free-living copepods are intermediate hosts of human parasitic tapeworms and nematodes.

Tantulocarida

- Tantulocarida - only recently described.
- Approximately 12 species.
- Tiny copepod-like ectoparasites of deep-sea benthic crustaceans.



Class Thecostraca

- **Barnacles** – **class Thecostraca**– are a group of mostly sessile crustaceans whose cuticle is hardened into a shell.



A



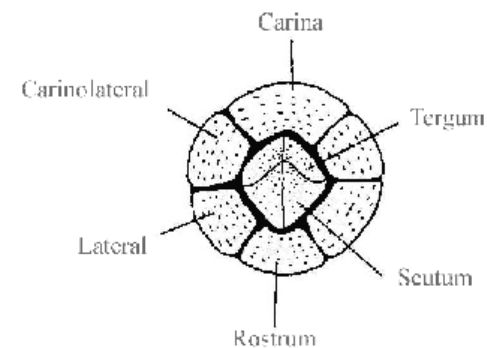
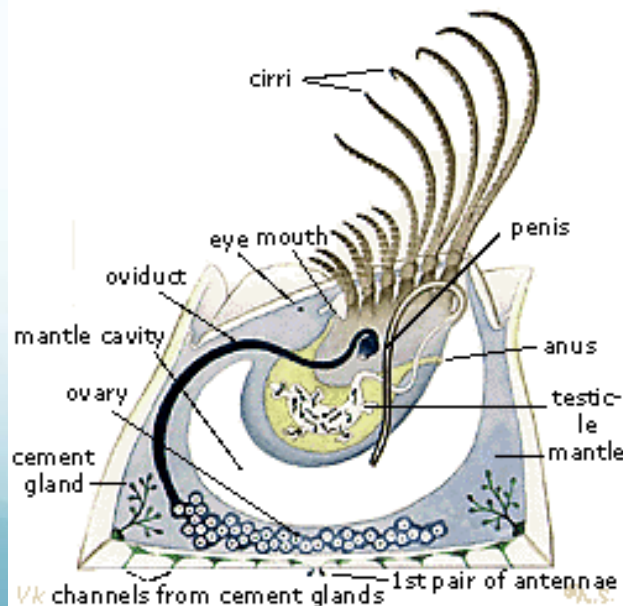
B

Class Thecostraca

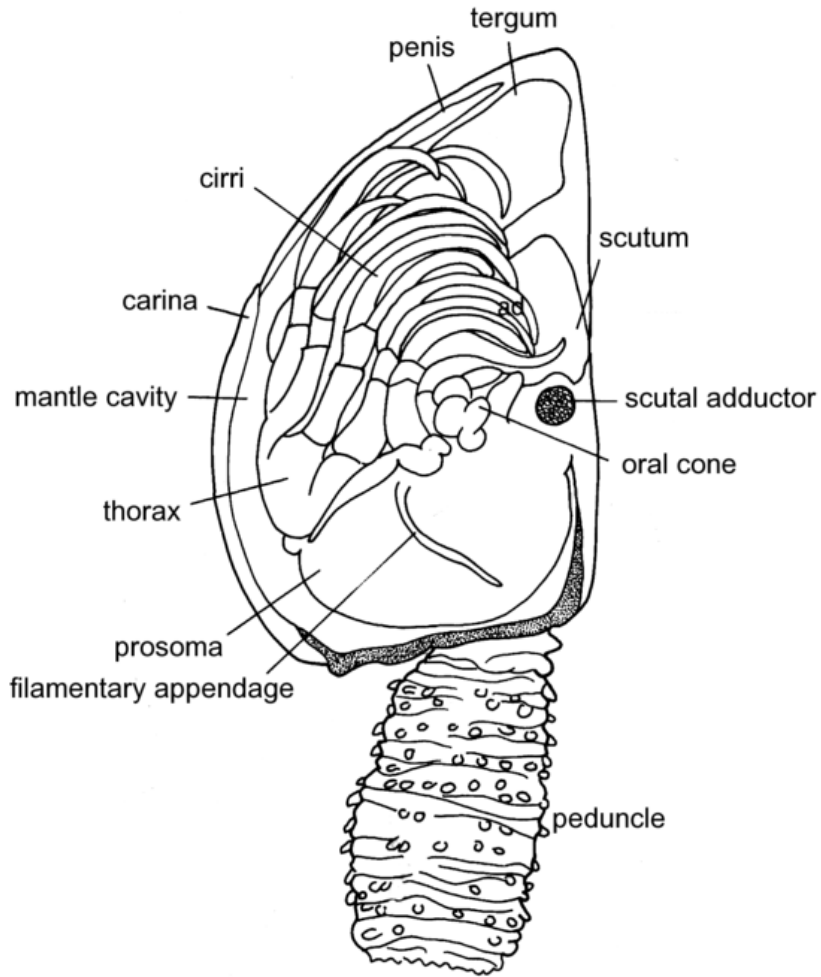
- Their legs are long, many jointed **cirri** (pronounced "seer-eye"), that extend out through the calcareous plates to filter feed.



© 2004 Al Danielsbeck



Goose barnacles (order **Pedunculata**), also called **stalked barnacles** or **gooseneck barnacles**, are filter-feeding crustaceans



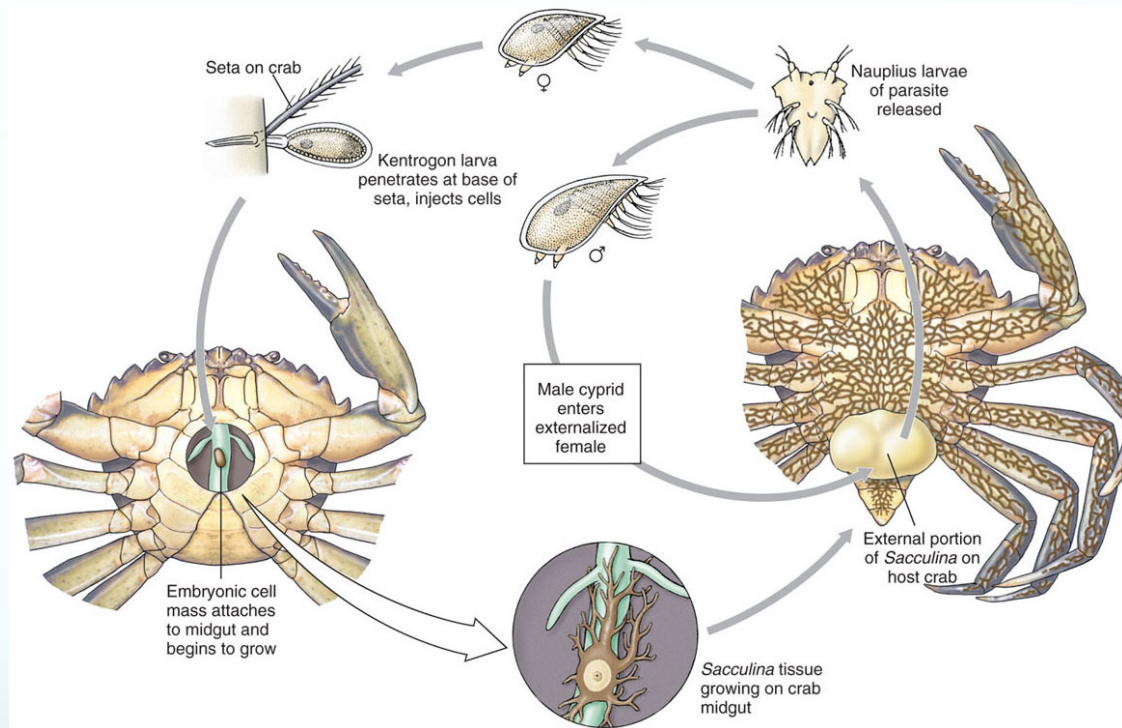
Class Thecostraca

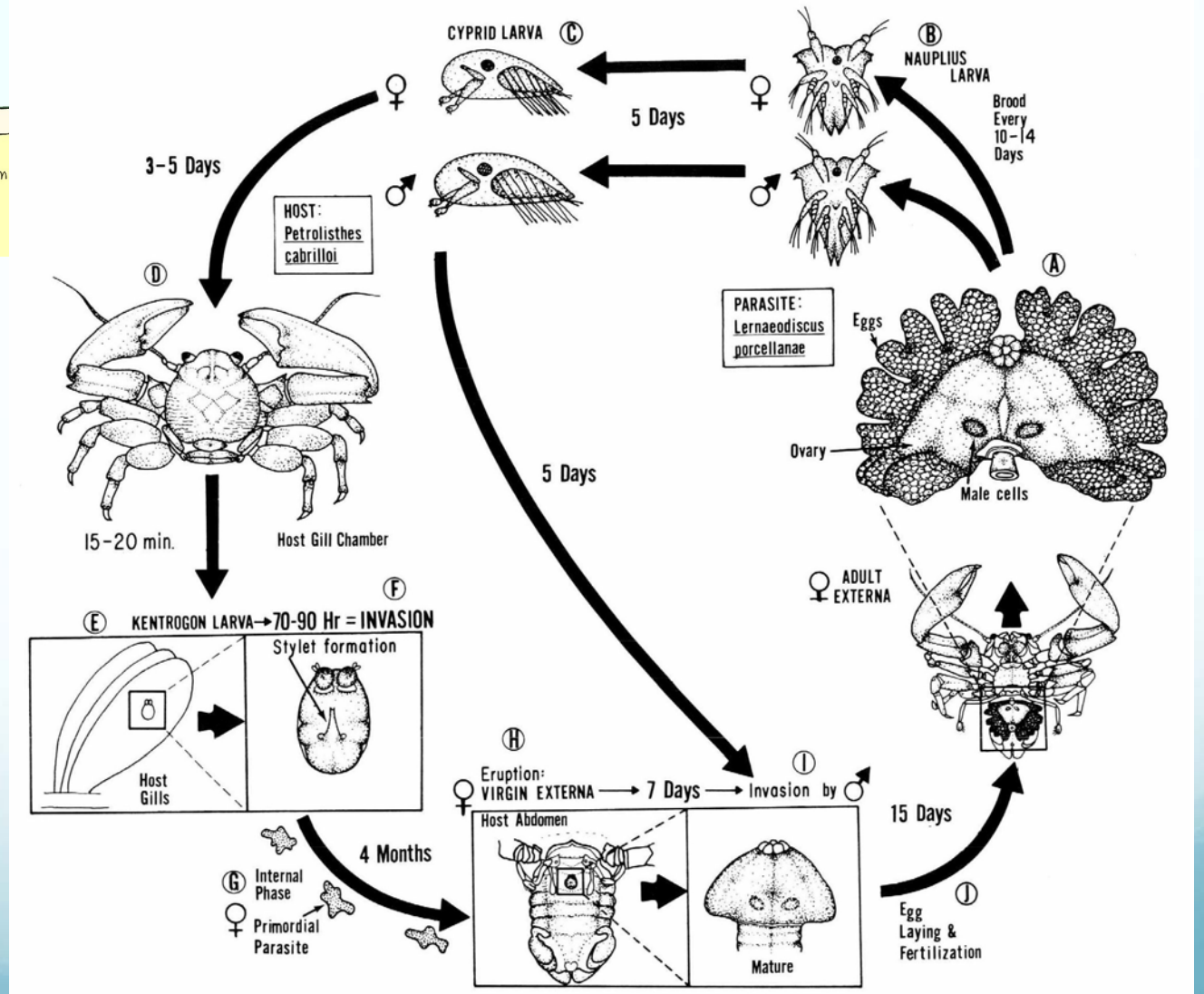
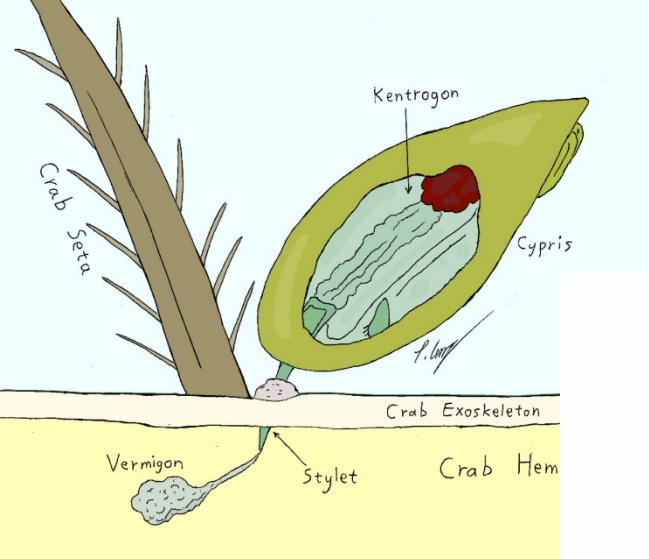
- Barnacles are hermaphroditic.
- Most hatch as a **nauplius** larva then become a **cyprid** larva (resembles the ostracod *Cypris*).
- Cyprids attach to the substrates and begin secreting calcareous plates.



Class Thecostraca

- Parasitic forms may have a kentrogon stage that injects cells into the hemocoel of host.



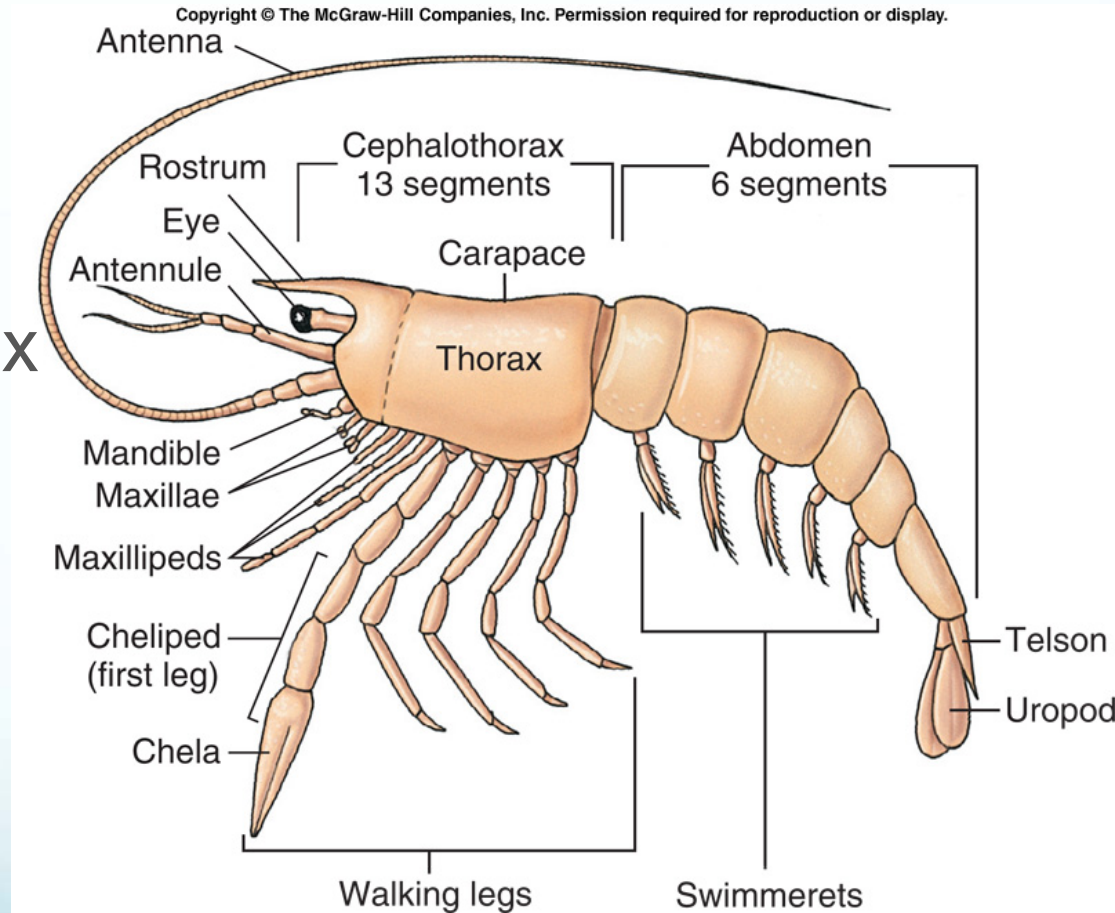


Class Malacostraca

- Largest and most diverse class of Crustacea with over 20,000 species.
- Contains three subclasses, 14 orders, and many suborders.

Class Malacostraca

- **Malacostracans** usually have a head with 5 fused segments, a thorax with 8 segments and an abdomen with 6.
- Anterior **rostrum**
- Posterior **telson**



Class Malacostraca – Order Isopoda

- **Order Isopoda** – including pill bugs.
 - Only truly terrestrial crustaceans.
 - Also have marine and freshwater forms.
 - **Dorsoventrally flattened**, lack a carapace, and have sessile compound eyes.



Class Malacostraca – Order Amphipoda

- **Order Amphipoda** – many marine, terrestrial & freshwater forms.
- Amphipods resemble isopods:
 - Lack a carapace, have sessile compound eyes, and one pair of maxillipeds.
- However, they are compressed laterally.
- Development is direct - the hatching stage is simply a small version of the adult or skip the early development stage



A



B

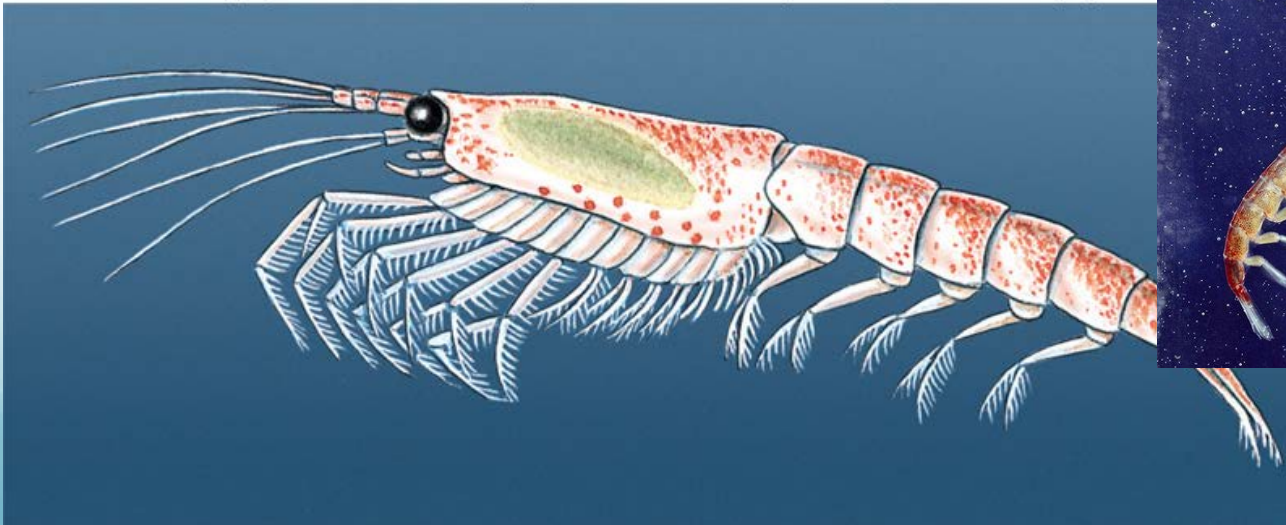


C

A: © Kjell Sandved/Visuals Unlimited; B,C: © Kjell Sandved

Class Malacostraca – Order Euphausiacea

- **Order Euphausiacea** contains approximately 90 species.
- Includes important ocean plankton called **krill**.
- Most are bioluminescent with a light-producing organ called a **photophore** (its function is not understood).
- Form a major component of the diet of baleen whales and of many fishes.
- Eggs hatch as nauplii.



Class Malacostraca

- **Decapods** – **order decapoda** – are all relatively large crustaceans and include lobsters, crabs, crayfish, and shrimp.
- 3 pairs maxillipeds & 5 pairs walking legs.



A



B



C



D



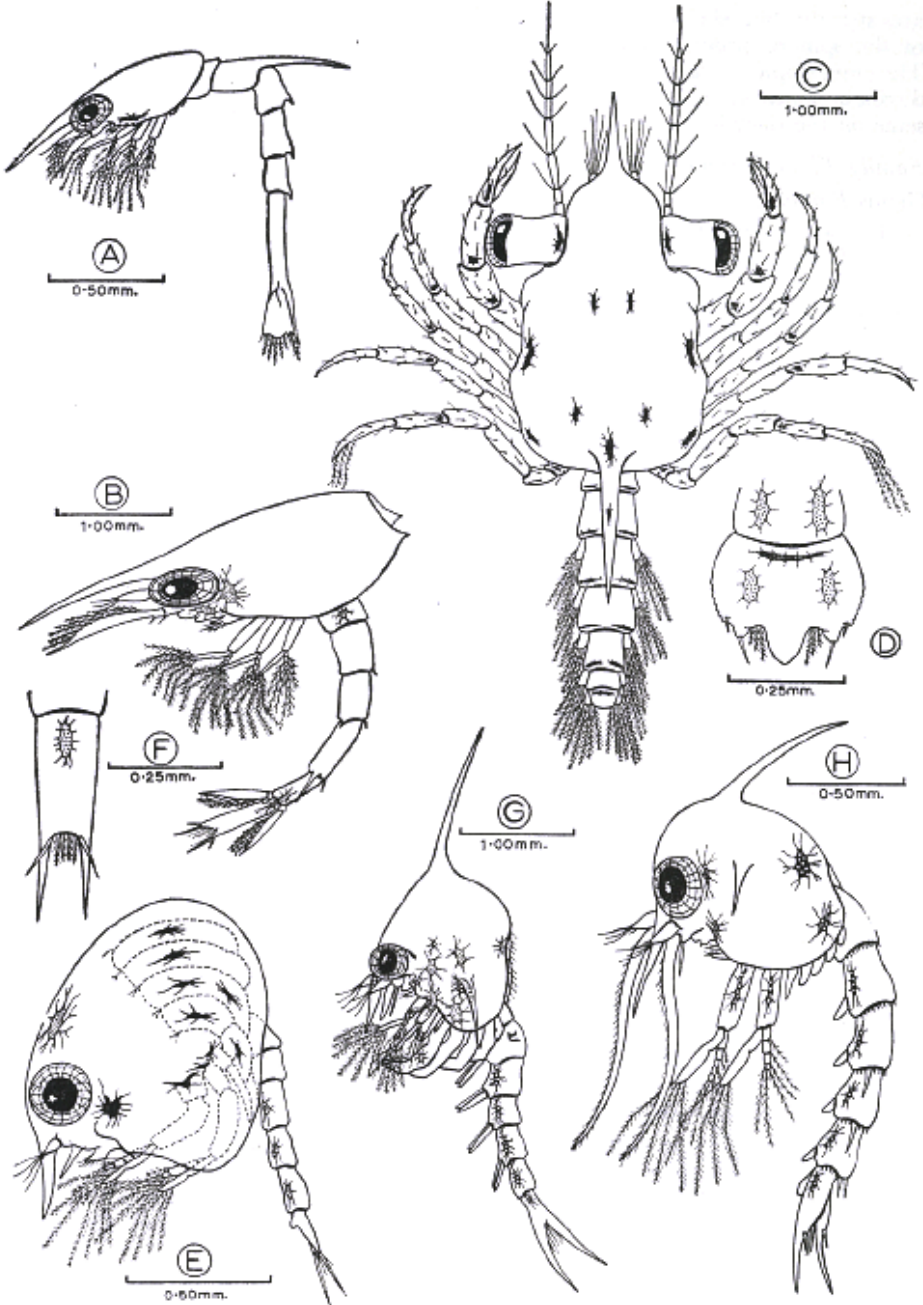
E

Class Malacostraca

- Harder, heavy plates in larger crustaceans due to calcareous deposits in addition to chitin.
- The carapace covers much or all of the cephalothorax.

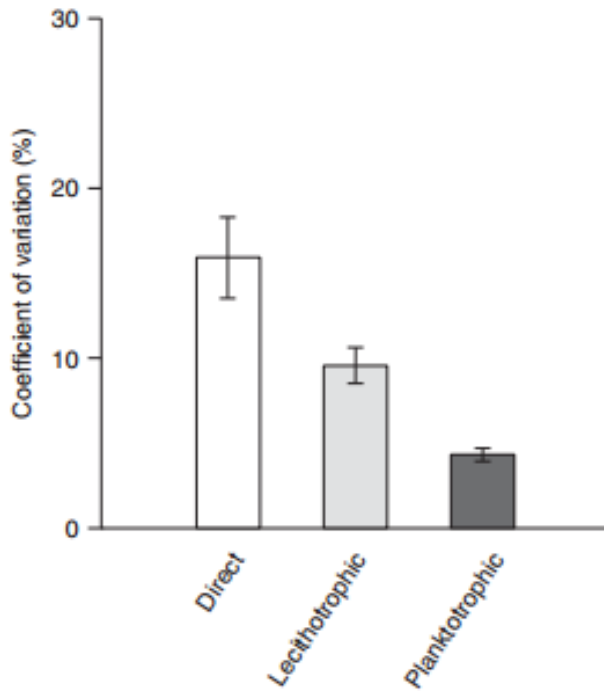


Zoea and megalopa larvae



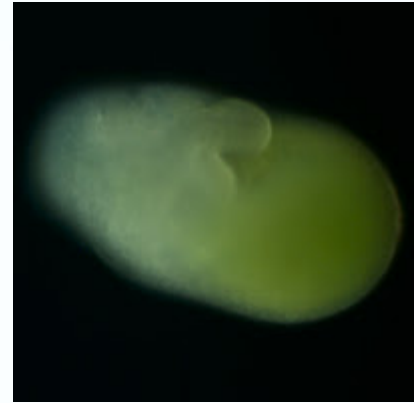
Development

- Offspring size



(Marshall and Keough 2008)

Lecithotrophy, meaning “feeding on yolk”, refers to development with a non-feeding larva, which depends on the egg’s yolk reserve supplied by the mother.



Planktotrophy, meaning “feeding on plankton” refers to development via a larva that must feed in the plankton in order to develop to metamorphosis.



Offspring Type

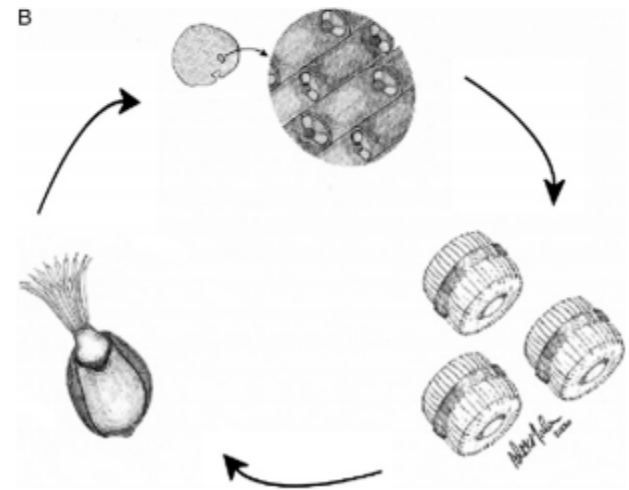
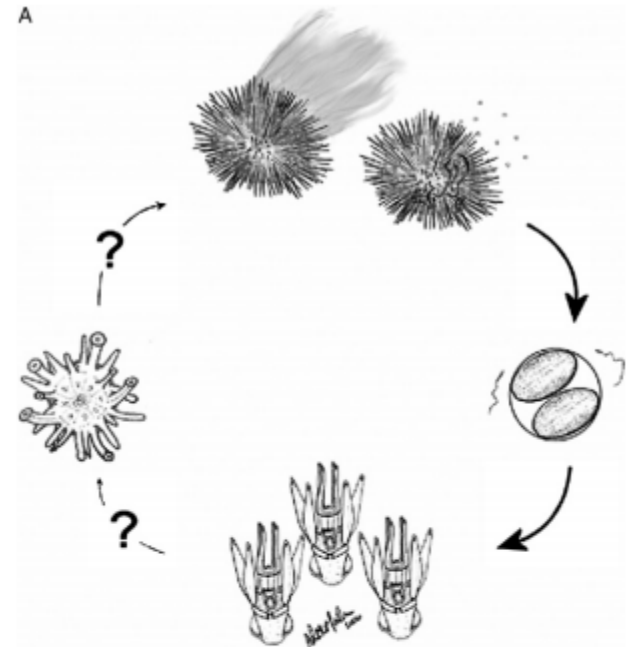
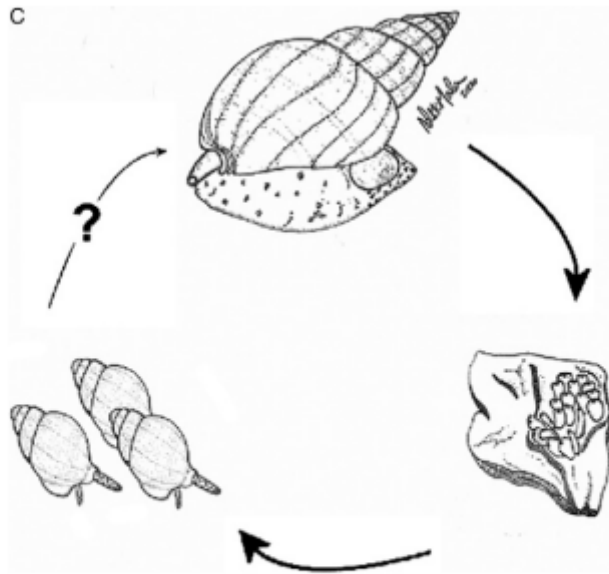
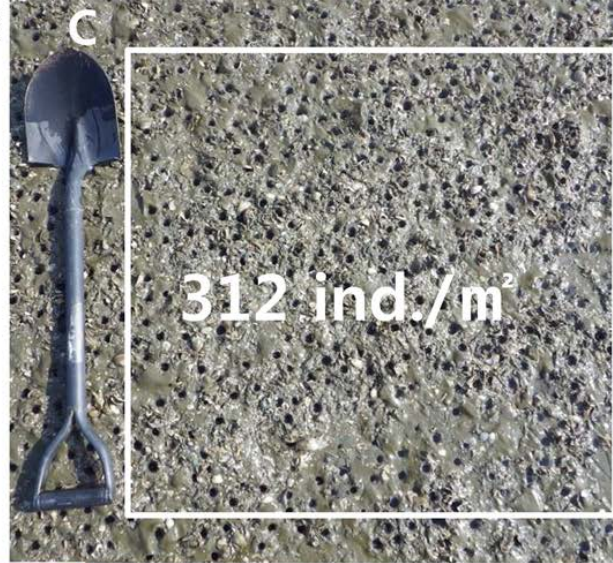
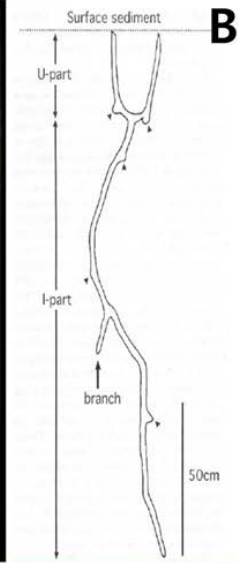
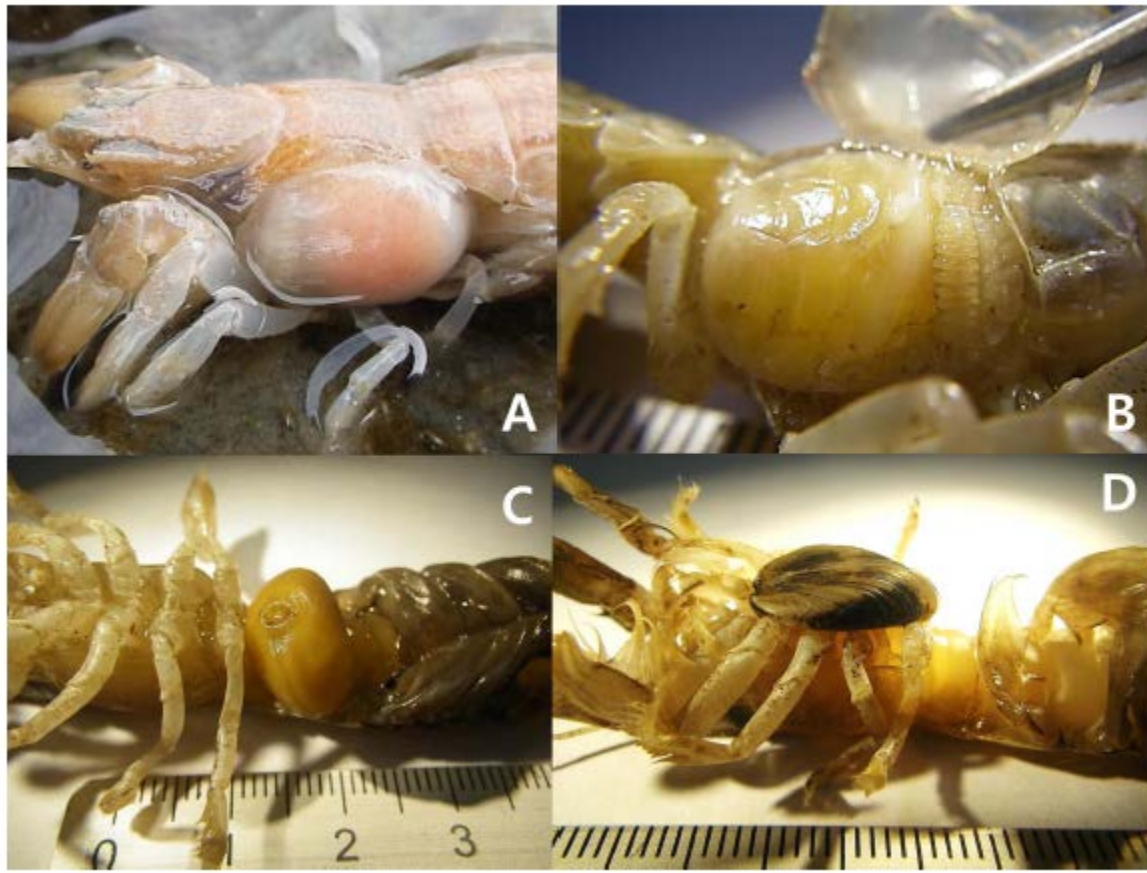
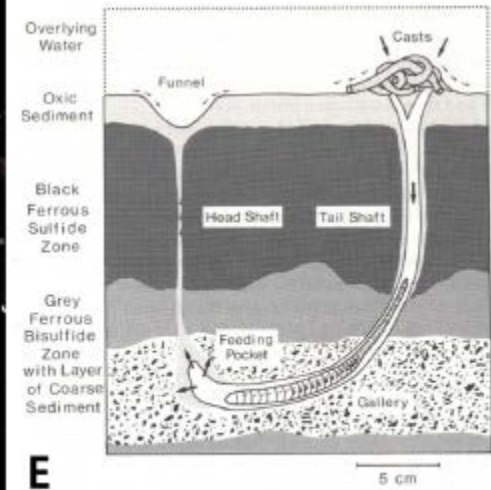


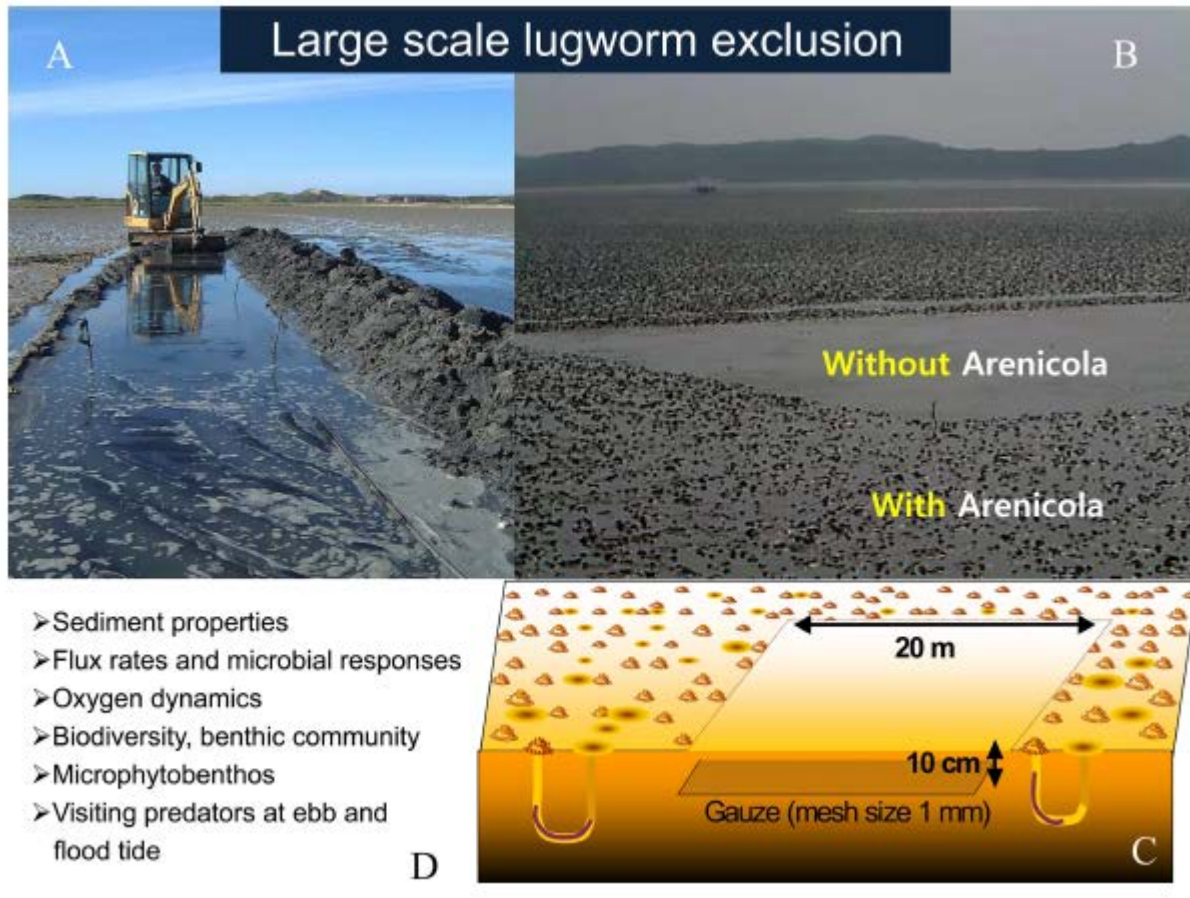
Figure 1.7 Summaries of the effects of offspring size on the various life-history stages of (A) a 'typical' planktotrophic species with external fertilization, (B) a 'typical' lecithotrophic species with internal fertilization and (C) a 'typical' species with direct development. Arrows indicate that we believe there is strong effect of offspring size on that particular life-history stage and question marks indicate that the effects at this stage have not been examined.











- <https://www.youtube.com/watch?v=66p3eNtbypU>
- <https://www.youtube.com/watch?v=b7UFjsAYr3Y>