BIO 475 - Parasitology
Spring 2009

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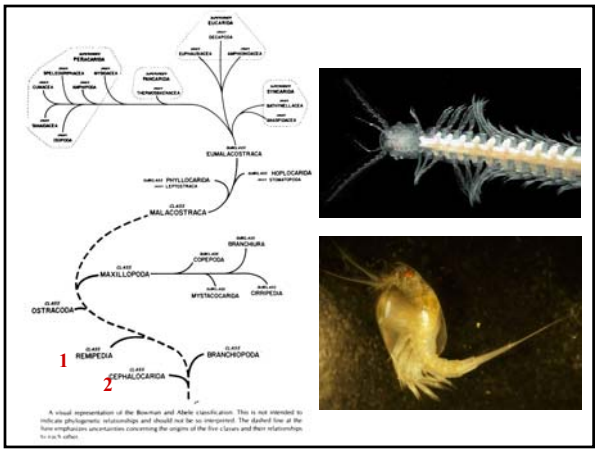
Northern Arizona University

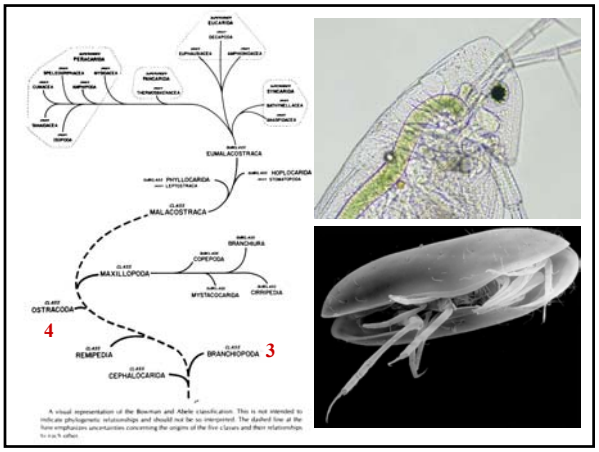
http://www4.nau.edu/isopod

Lecture 23

Crustacea: 5 Major Classes

1. Remipedia - look like centipedes
2. Cephalocarida - well developed head shield
3. Branchiopoda - water fleas, etc.
4. Maxillopoda - copepods and barnacles
5. Malacostraca - higher crustacea

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BRANCHIOPODA
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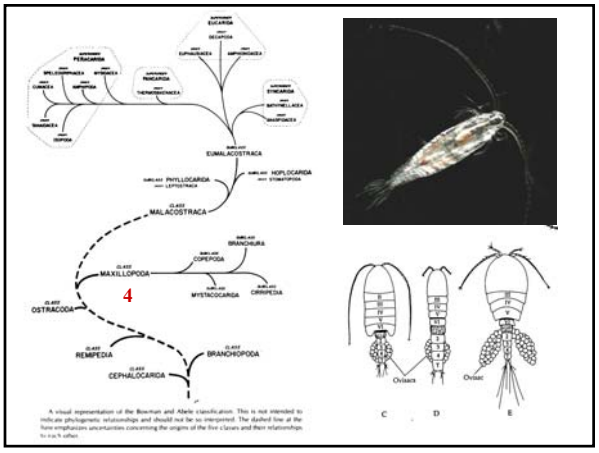
CEPHALOCARIDA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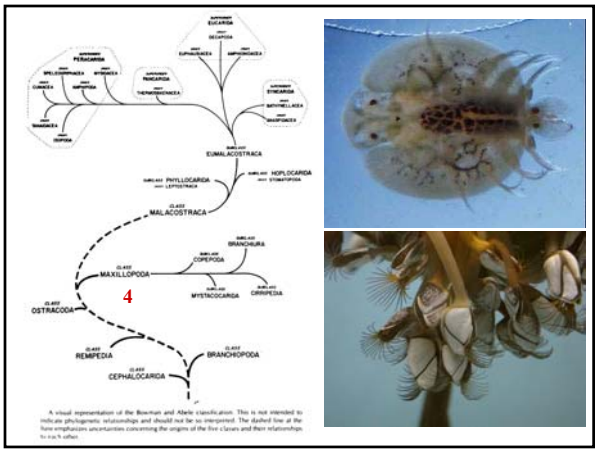
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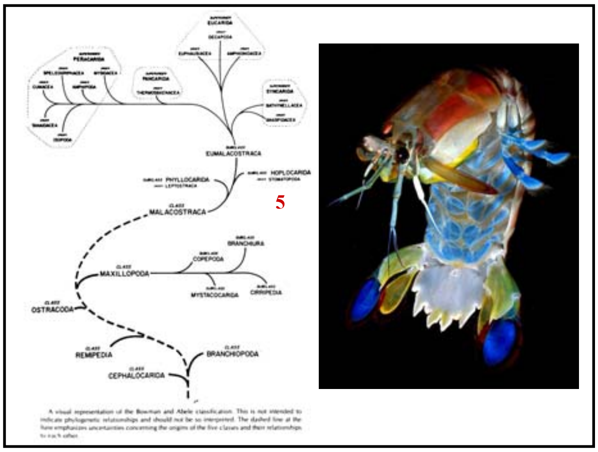
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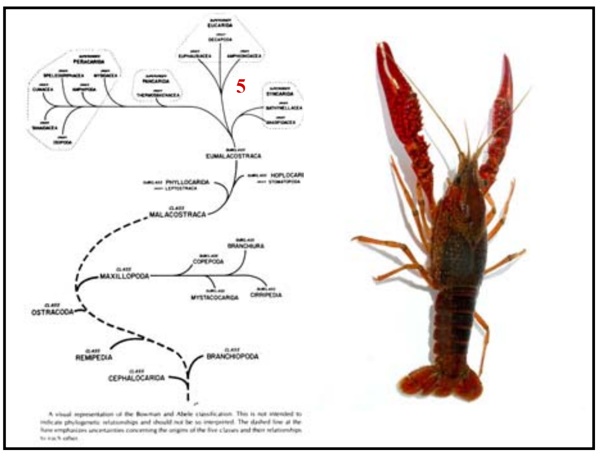
A visual representation of the Bowman and Abele classification. This is not intended to indicate phylogenetic relationships and should not be so interpreted. The dashed line at the base emphasizes uncertainties concerning the origins of the five classes and their relationships to each other.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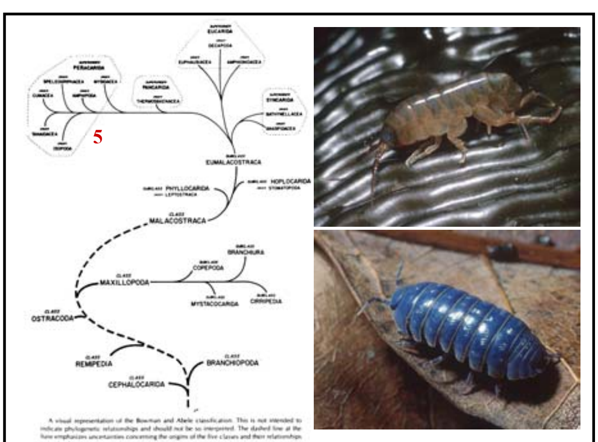
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Class Maxillopoda

1. Mostly small crustaceans, with some exceptions

2. Shortened bodies, reduced abdomen, with few or modified legs

Class Maxillopoda

3. A "naupliar" eye in many groups

a. Or "maxillopodan eye"

b. Retention of larval characteristics - *paedomorphosis*

c. possible role of this process in producing this group

4. possibly polyphyletic too.

Class Maxillopoda

5. Systematics

a. 6 major subclasses

1. Ostracoda -

2. Mystacocarida -

3. Copepoda

4. Branchiura

5. Cirripedia

6. Tantulocarida

Class Maxillopoda

5. Systematics

a. 6 major subclasses

1. Ostracoda -

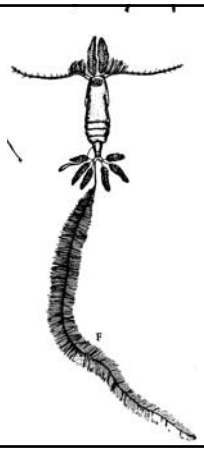
2. Mystacocarida -

3. Copepoda

4. Branchiura

5. Cirripedia

6. Tantulocarida



Subclass Copepoda

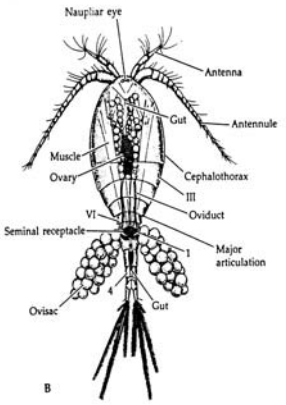
1. Large and diverse, again mostly quite small.

2. Usually teardrop shaped or elongate.

a. Large antennae.

b. Often with single maxillopodan eye.

c. Females with dangling egg sacs.



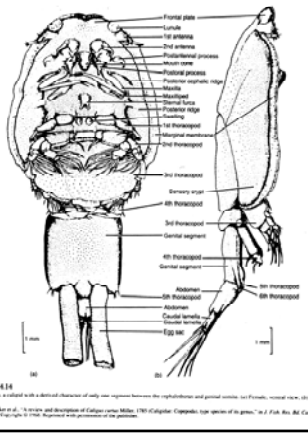


FIGURE 34.14

Caligus spp.

Ectoparasites of fish

Species of parasitic sea lice currently affecting farmed fish

Species	Known range	Hosts
Lepeophtheirus salmonis	North Atlantic and north Pacific	Specific to salmonid species e.g affecting farms in Atlantic salmon
Salmo salar	Canada, USA, Japan & Europe	Pacific salmon, *Onchorhynchus sp*, Arctic *charr Salvelinus*
Caligus elongatus	Atlantic coast of Canada	Not host specific - found on > 80 species of fish including salmonids
Caligus curtus	Atlantic coast of Canada	Not host specific - occasionally found on salmonids
Caligus clemensi	Pacific coast of Canada, USA	Not host specific - occasionally found on salmonids
Caligus rogercresseyi	Pacific coast - Chile	Not host specific - found mostly on salmonids in Chile (previously *C. flexispina*)
Caligus teres	Pacific coast - Chile	Occasionally found on salmonids in Chile

Caligus lacustris

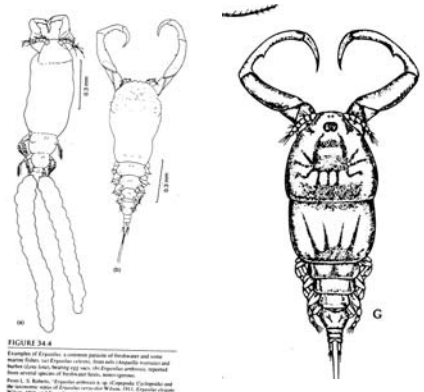


FIGURE 34.4

FIGURE 34.5

Antenna of *E. centrarchidarum*, a common parasite of members of the sunfish family (Centrarchidae). The antennae of *Ergasilus* are usually modified into a powerful organ used to grasp their host's gill filament, with the third and fourth joints opposable with the second.

From L. S. Roberts, "*Ergasilus* (Copepoda: Cyclopoida): revision and key to species in North America," in *Trans. Am. Microsc. Soc.* 89:134–161. Copyright © 1970. Reprinted with permission of the publisher.

Ergasilus has a direct life cycle using only the fish as a host.

Ergasilus can spend prolonged periods swimming free, and mating takes place while the male and female are swimming. The male then dies.

Egg incubation occurs while the egg clusters are attached to the female.

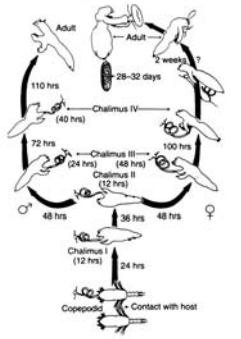


FIGURE 34.19

Life cycle of *Salmincola californiensis*. The time periods in parentheses refer to the duration of each stage, whereas those without parentheses denote time from first contact with host.

From Z. Kabata and B. Cousens, "Life cycle of *Salmincola californiensis* (Dana, 1852) (Copepoda: Lernaeopodidae)," in *J. Fish. Res. Bd. Can.* 30:881–903. Copyright © 1973. Reprinted with permission of the publisher.

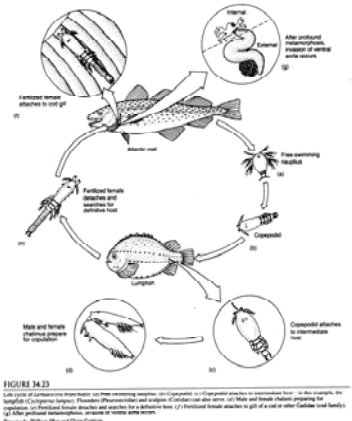
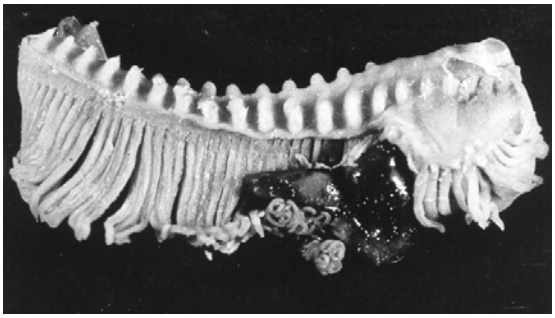
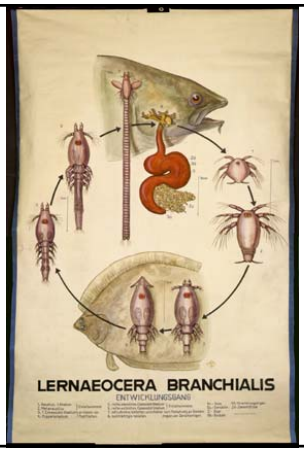


FIGURE 34.23





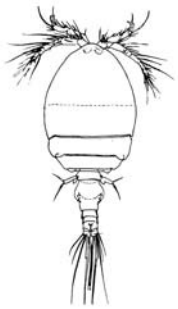


FIGURE 34.9

Typical lichomolgid, *Ascidioxynus jamaicensis*, from the branchial sac of an ascidian, *Ascidia atra* (dorsal view of female).

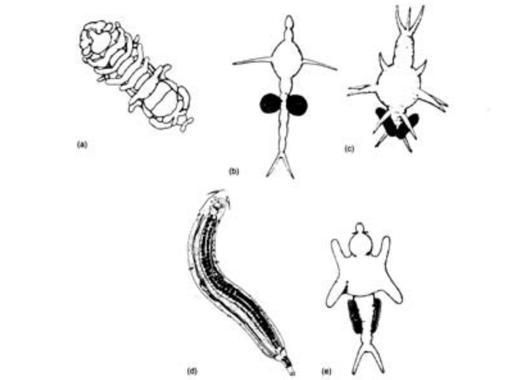
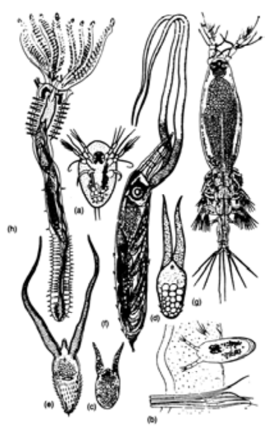


FIGURE 34.10

Philichthyids, parasites in subdermal canals of fish. (a) *Philichthys xiphiae*; (b) *Sphaerifer leydigi*; (c) *Colobomatus sciaenae*; (d) *Lerneascus nematoxys*; (e) *Colobomatus muraenae*.

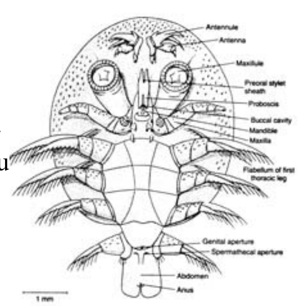
From Z. Kabata, "Crustacea as enemies of fishes," in *Diseases of Fish*, book I, edited by S. F. Snieszko and H. R. Axelrod. Copyright © 1970 T.F.H. Publications, Inc., Neptune City, NJ.

Order Monstrilloida



Subclass Branchiura

1. Entirely parasitic.
2. Includes *Argulus*.
3. Now appears to inclu the Pentastomida



Subclass Cirripedia

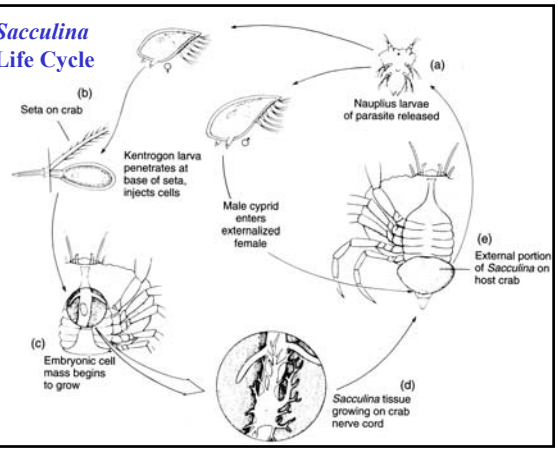
1. Bodies highly modified for attachment
   a. Extreme reduction of posterior body and appendages
   b. Body attached to substrate with "test"
   c. Body also may be attached by stalk.

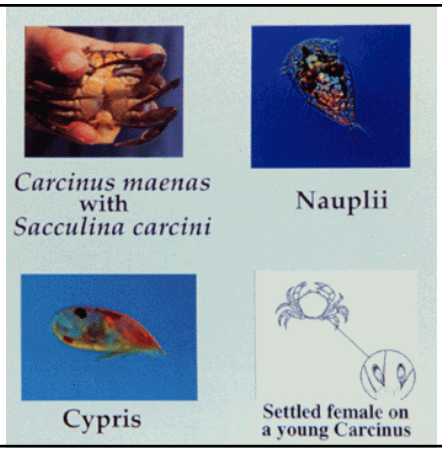
Subclass Cirripedia

2. Huge and diverse group - most of systematics by Charles Darwin.
   a. Much of his work remains intact today.
3. Larval stages are motile, then settle on substrates.

Phylum Arthropoda, Subphylum Crustacea, Class Maxillopoda, Subclass Cirripedia, Order Rhizocephala

Sacculina Life Cycle



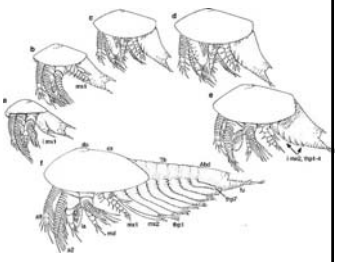


Subclass Tantulocarida

1.Entirely parasitic on other crustaceans.

a.Mostly on mysids and krill.

2. Life cycles similar to rhizocephalans except it has parthenogenetic and sexual reproductive cycles.



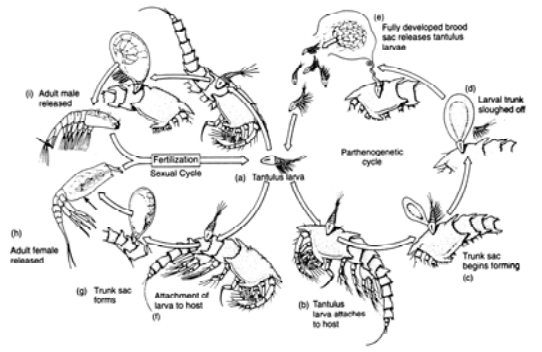
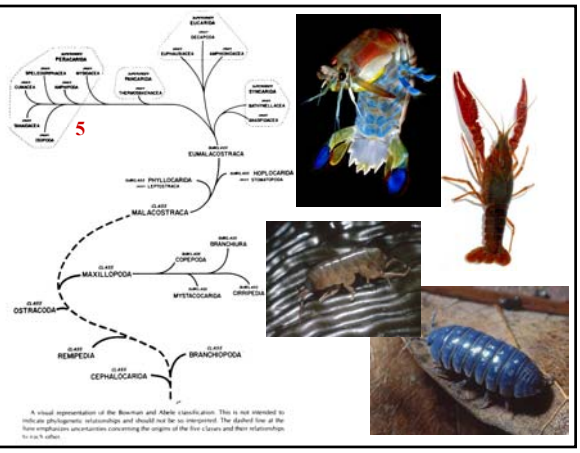


FIGURE 34.30

Presumed life cycle of tantulocarids. Positions of genital apertures of free-swimming sexual stages marked with *small arrows*. Parthenogenetic cycle: (a) Tantulus larva; (b) tantulus larva attaches to host; (c) trunk sac begins forming; (d) larval trunk is sloughed off; (e) fully developed brood sac releases tantulus larvae. Sexual cycle: (f) tantulus larva attaches to host; (g) trunk sac forms; (h) adult female is released; (i) adult male is released.
Source: Based on R. Huys et al., "The tantulocaridan life cycle: the circle closed?" in *J. Crustacean Biol.* 13:432–442. Drawing by William Ober and Claire Garrison.

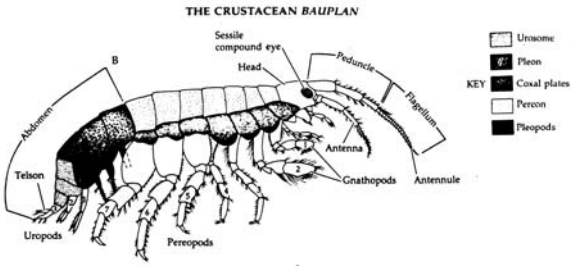
Class Malacostraca

1. Huge and diverse group - the most familiar crustaceans
   a. Over 20,000 species - probably many more
2. Generally with well developed head, thorax and abdomen
   a. Serial modification of appendages



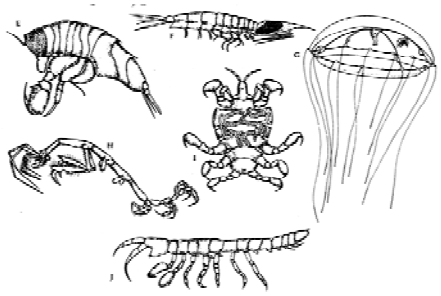
Subclass Peracarida

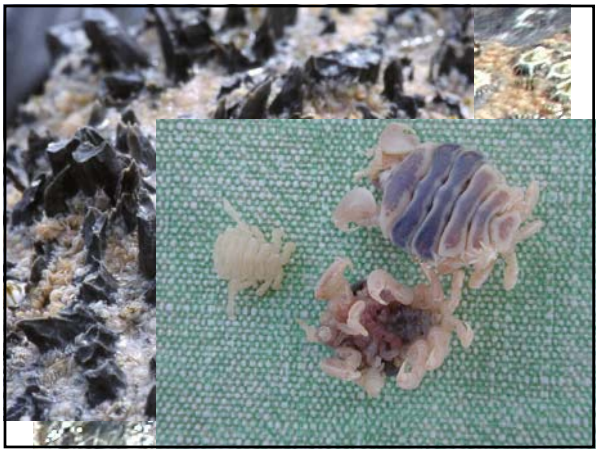
1. Isopods, amphipods and tanaids
   a. Contain most of parasitic malacostcan taxa.



Order Amphipoda

1. Laterally compressed
   a. Lots of diversity.





Cyamus,
Paracyamus

Ectoparasites of cetaceans

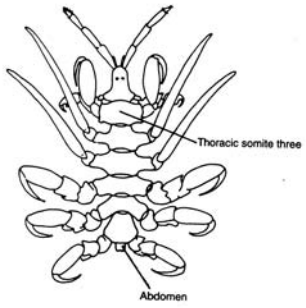


FIGURE 34.31

Paracyamus, an amphipod parasite of whales. Cyamids are ectoparasites and are dorsoventrally flattened with several pairs of legs modified for clinging to their hosts.

From G. O. Sars, from W. T. Calman, "Crustacea." Copyright © 1909. In *A Treatise on Zoology*, vol. 8, edited by R. Lankester. Adams & Charles Black, London.

Order Isopoda

1. Dorsoventrally compressed
   a. Also lots of diversity.

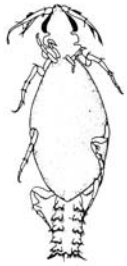
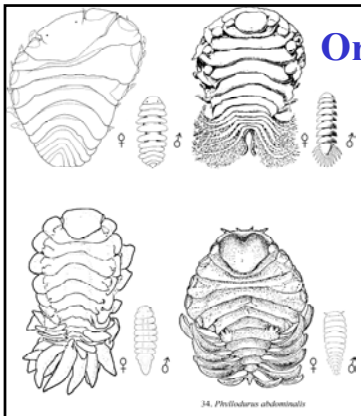


FIGURE 34.32

Praniza larva of the isopod *Gnathia*. The praniza is the only parasitic stage of this isopod. The gut becomes greatly distended with blood from its fish host.

From Z. Kabata, "Crustacea as enemies of fishes," in *Diseases of Fish*, book 1, edited by S. F. Snieszko and H. R. Axelrod. Copyright © 1970 T.F.H. Publications, Inc., Neptune City, NJ.

Gnathiidae:
Praniza are parasitic on fish.
Adults live in cavities
Extreme sexual dimorphism

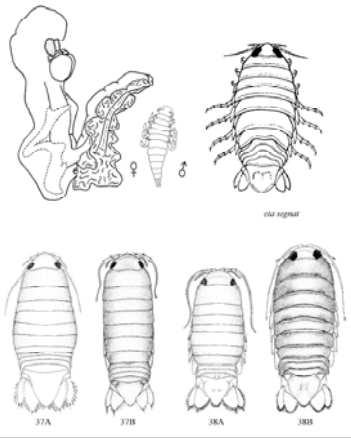


Order Isopoda

Bopyridae: Parasitic on decapod crustaceans. Environmental sex determination. Extreme sexual dimorphism of a different kind.

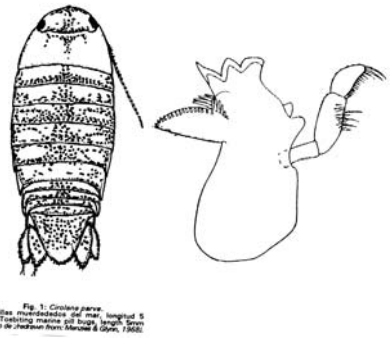
Order Isopoda

Aegidae, Cymothodae and Cirolanidae: Parasitic on crustaceans or fish or opportunistically on predaceous or parasitic.



Order Isopoda

1. Dorsoventrally compressed
   a. Also lots of diversity.



Subphylum Hexapoda (Insecta)

1.Characteristics

a. Six legs,

b. Head, thorax abdomen

c. Often with winged adults

2. Main Parasitic Orders

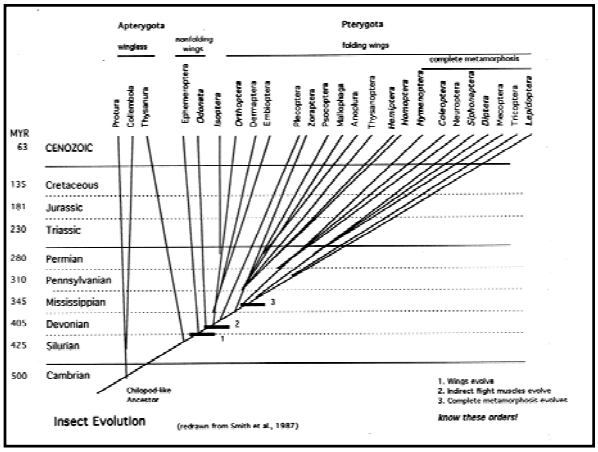
a. Mallophaga

b. Anoplura

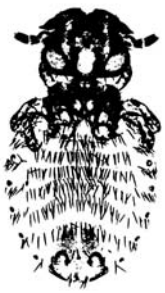
c. Hemiptera

d. Siphonaptera

e. Diptera



Order Mallophaga



(b)

FIGURE 35.6

Trichodectes canis (Mallophaga, Ischnocera), the chewing louse of dogs. (a) Male; (b) female.
Courtesy of Jay Georgi.

FIGURE 35.5

Columbicola columbae (Mallophaga, Ischnocera), the slender pigeon louse.
Courtesy of Jay Georgi.

Order Anoplura

Order Anoplura

1.Vectors of disease
a. *Rickettsia* (typhus)
b. *Rhochalimaea* (trench fever)
c. *Borrelia* (relapsing fever)

2. Important species
a. *Pediculus humanus humanus* (clothing)
b. *Pediculus humanus capitus* (smaller, head)
c. *Phthirius pubis*