

# Part II

## Molluscan diseases and Defense in Mollusca

### **A-Virus, bacterial and fungal diseases**

- \* A- Virus diseases
- \* 1- Haemocytic Infection Virus disease (HIV)
- \* 2- Herpes-Type Virus disease
- \* 3- Gill Necrosis Virus (GNV) disease.
- \* 4- Oyster Velar Virus Disease (OVVD)
- \* 5- Virus-like particle

## A- Virus diseases

### - 1- Haemocyte Infection Virus disease (HIV)

It infected the two bivalves *Crassostrea angulata* and *C. gigas* and caused mass mortalities for their populations. It caused a weakness of adductor muscle, increase in the number of brown cells and acute inflammatory response associated with the haemocytes.

**hemocyte** is a cell that plays a role in the immune system of invertebrates. It is found within the hemolymph. Hemocytes are phagocytes of invertebrates)

### 2- Herpes-Type Virus disease

OsHV-1 (Oyster Herpes virus type 1) infection causes mortality in the larvae and juveniles of several bivalve species including the Pacific oyster *Crassostrea gigas*, *Ostrea edulis*, *Ruditapes decussatus*, *R. philippinarum* and *Pecten maximus*.

The virus can be found in adult bivalves without any mortality

**Infected larvae show a reduction in feeding and swimming activities and mortality can reach 100% in a few days.**

. The virus is associated with abnormal nuclei through connective tissues, especially in mantle, labial palps, gills, and digestive gland.

### **3-Gill Necrosis Virus (GNV) disease.**

The Icosahedral DNA virus infected the gills of *Crassostrea angulata* and *C. gigas* cultured in France and **caused extensive gill erosion with high mortalities in their populations**

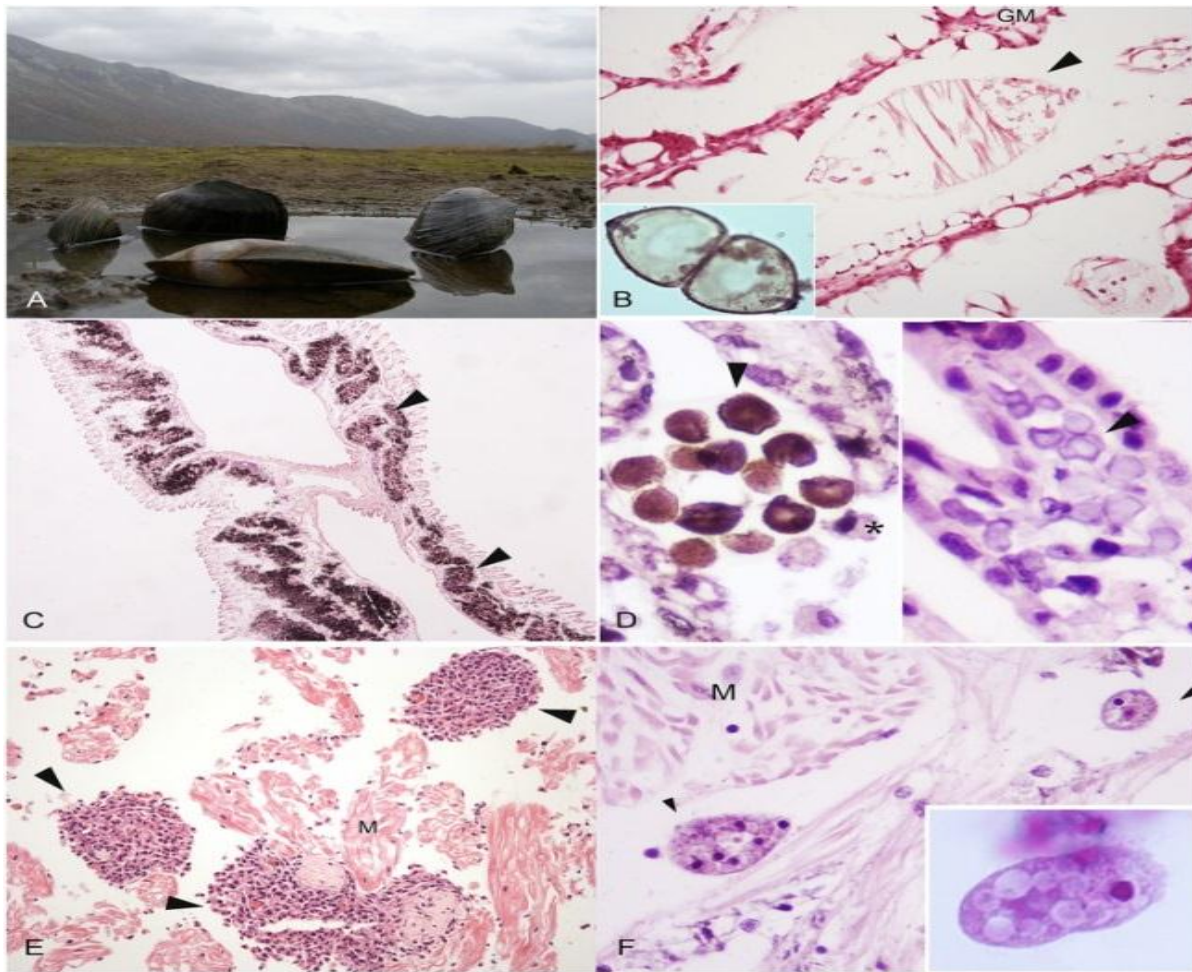
## 4-Oyster Velar Virus Disease (OVVD)

It infected velar epithelium of *Crassostrea gigas* larvae and causes severe hatchery losses (100%)

## 5-Virus-like particle

**The virus-like particle is determined in *Octopus vulgaris* .**

The virus-like pathogen caused edematous nodular tumors on the tentacles, ventral side of the mantle and siphon of octopuses .



**Macro-microscopical observation of pathogen and disease in freshwater mussel species. (A)** *Anodonta cygnea* from Matese Lake (Caserta, Campania region) H&E; **(B)** Glochidium of *Anodonta woodiana* in the gill marsupium (GM), H&E, 40X; **(C)** Calcium Concretions (arrowheads) in the gills of *Unio pictorum* visible in black, Von Kossa Stain, 20X; **(D)** Calcium concretions in gills: Stain for Copper (Left), H&E (right) 40X; **(E)** Inflammatory nodulation (arrowheads) in heart muscle fibers (M) in *A. anatina* E&E. 40X. **(F)** *Conchophthirus* spp. (arrowheads) in the mantle of *Unio*

# Bacterial diseases

## -Nocardiosis (Fatal inflammatory bacteraemia)

bacteria *Nocardia crassostreae* infected *Crassostrea gigas* and *Ostrea edulis* and caused focal necrosis, multiple abscesses and summer mortalities of the population .

## Brown ring disease

It was recorded from the clams *Tapes philippinarum* and *T. decussatus*. The bacteria adhere to the surface of the periostracal lamina at the mantle edge of the shell causing a brown deposit of organic material. The infection disturbs the normal calcification process

Infected clams had a significant decrease in glycogen suggesting that mass mortalities could result from the degeneration on metabolic activity The disease caused mass mortalities in cultured clam beds along the west coast of France.

## \* C- Fungal diseases

**The fungal disease is limited to the shell of oysters, first appearing as small round white spots, which are slightly raised and have a clear center.**



## II- PARASITES OF MOLLUSCA

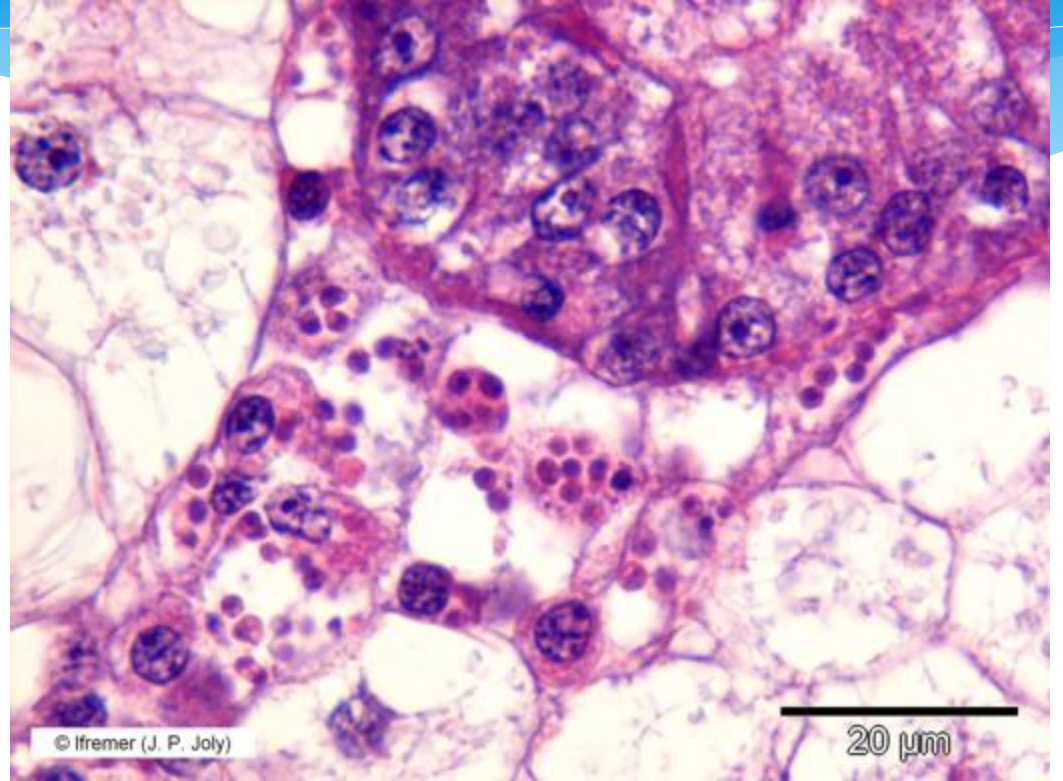
Mollusca are hosts for several parasites of **Protozoa, adult and larval stages of trematodes, nematodes and mites**

### Protozoa

The majority of the Protozoa are **free living and are found in almost every habitats** on land and in water. Though the parasitic Protozoa are smaller in numbers, but they assume **an important role as producers of global disease** which, apart from producing **death** or deformity, sap the energy and initiative and decay the normal fibers of organisms in many parts of the world

## - Microcell disease (Bonamiasis)

The parasite *Bonamia ostreae* has a significant negative impact on the host *Ostrea edulis* production. they have yellow discoloration and /or extensive lesions in the connective tissues of the gills, mantle and digestive gland. Actual pathology appears correlated to haemocyte destruction and diapedesis ( **the passage of blood cells through the unrupturewall of a blood vessel into the surrounding tissues** due to proliferation of *B. ostreae*



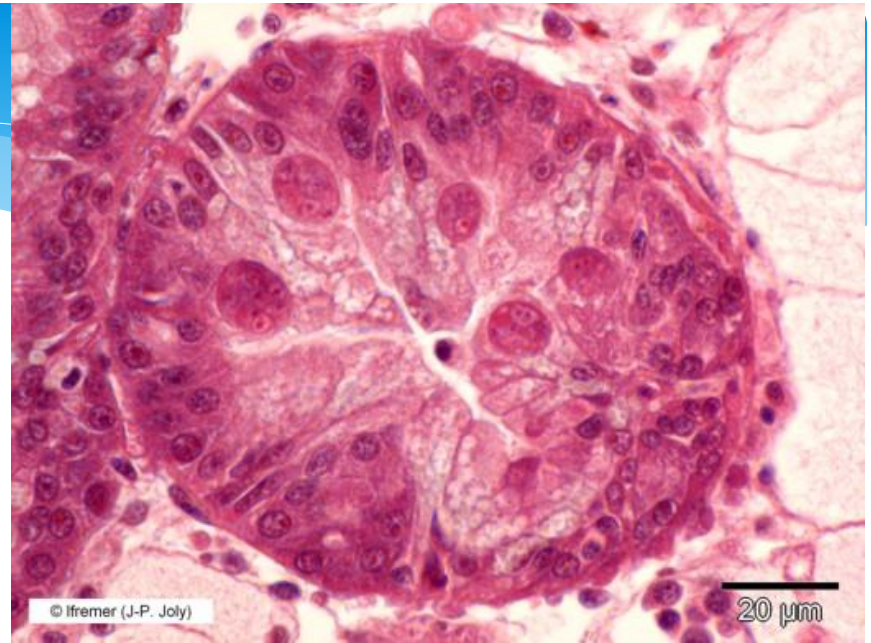
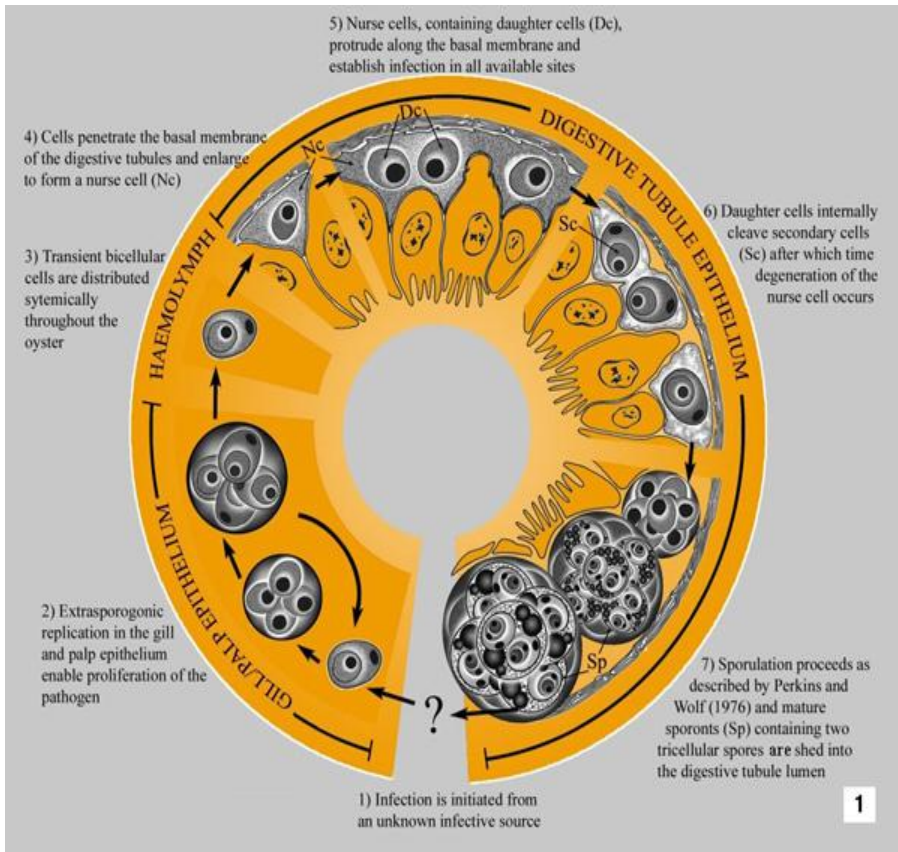
© Ifremer (J. P. Joly)

20 μm

## 2- QX disease

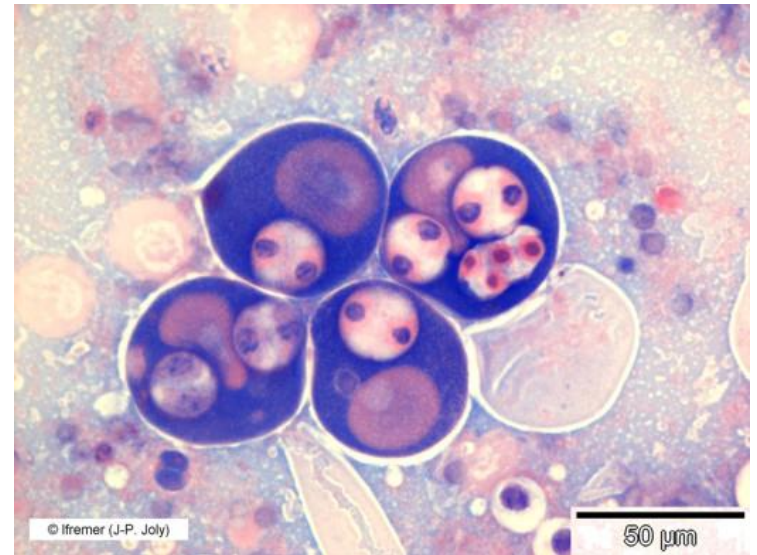
'QX' stands for 'Queensland Unknown', the title given to this disease before scientists discovered the parasitic organism that we now know causes it.

This disease appeared as a massive invasion of the digestive gland epithelial cells of the host *Saccostrea glomerata* by the parasite *Marteilia sydneyi* and leads to complete disorganization of the infected tissue



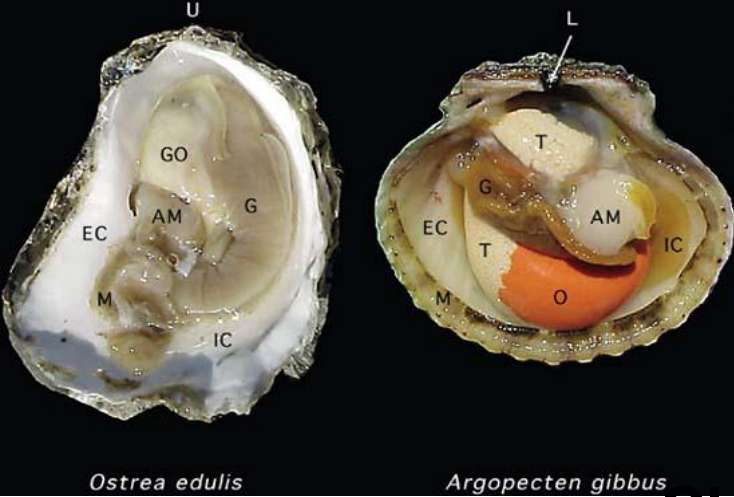
## - 3 - *Marteilioides* of oocytes (Oyster egg disease)

The parasite *Marteilioides chungmuensis* infected the ova of oysters *Crassostrea gigas* and *C. echinata* and caused egg mass like- multiple tumors with abnormal size delaying maturation stage



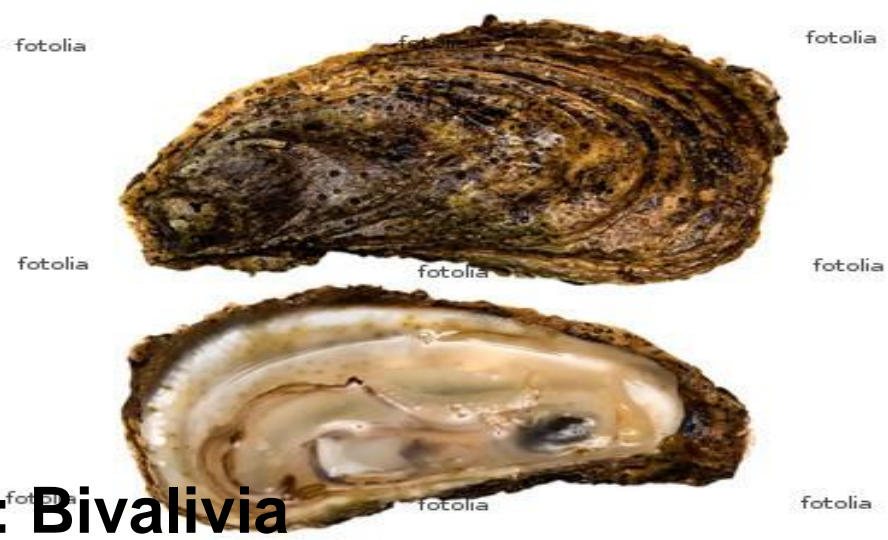
## \* 4- Yellow-spot disease

- \* The parasite produced yellow-spots on the subepidermal tissues of the body wall of the gastropod *Tritonia diamedea*.
- \* It was caused by the parasite of the marine protistan family, Thraustochytriaceae.
- \* Host amoebocytes became greatly flattened and formed a lamellated wall around the parasitic cells, which finally were enclosed in a dense, thick-walled, cellular capsule where they were generally seen to be necrotic.



*Ostrea edulis*

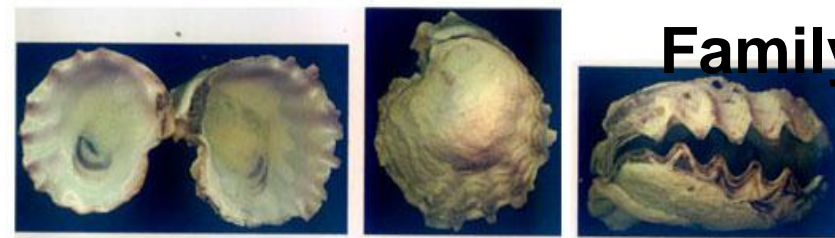
*Argopecten gibbus*



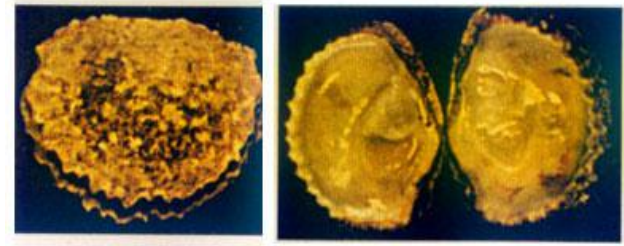
**Class: Bivalvia**

**Family: Ostreidae**

*Crassostrea virginica*



mm 40 - 46 - AQUILEJA



mm 60 - VENEZIA



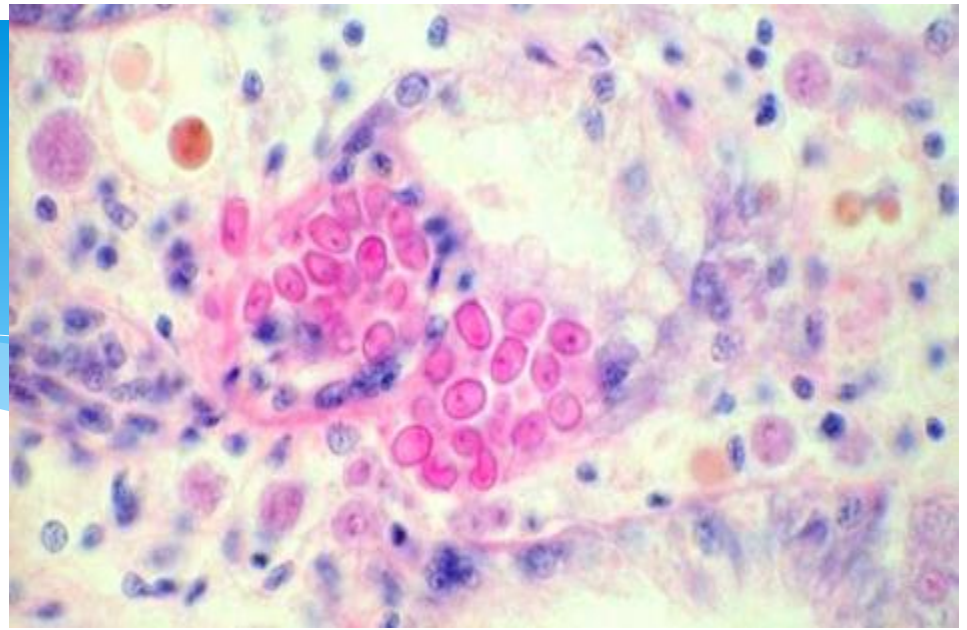
*Tritonia diomedea*

*Saccostrea commercialis*



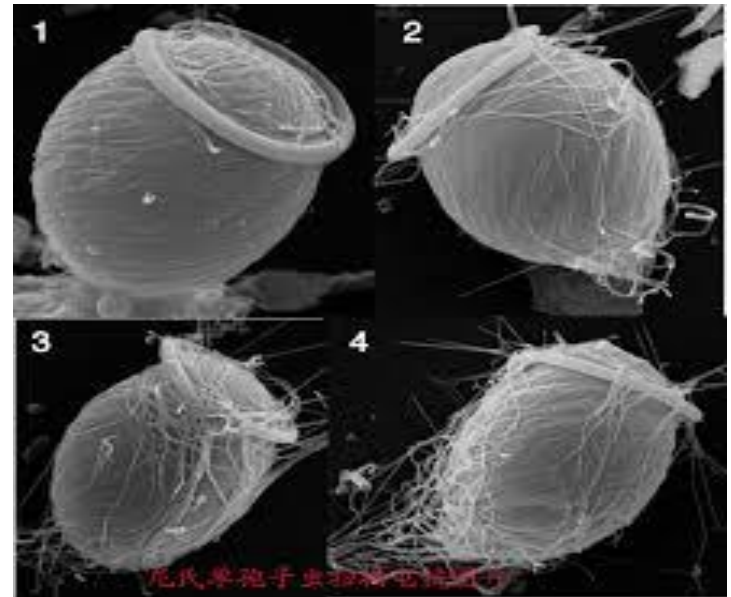
# Mussel- protozoan parasitism

<b>Hosts</b>	<b>Parasites</b>
<i>Physa</i> snails	<i>Minchinia pickordae</i>
<i>Crassostrea virginica</i>	<i>Minchinia nelsoni</i>
<i>Lepidochitona cinereus</i>	<i>Minchinia chitonis</i>
<i>Lasaea rubra</i>	<b><i>Minchinia haploraia</i></b>
<i>Mytilus californianus</i>	<i>Haplosporidium tumefacientis</i>
<i>M. californianus</i>	<i>Haplosporidium tumefacientis</i>
<i>Mytilus edulis</i>	<b><i>Haplosporidium sp.</i></b>
<i>M. galloprovincialis</i>	<i>Pseudoklossia semiluna</i>
<i>M. galloprovincialis</i>	<i>Marteilia refringens</i>
<i>Protothaca staminea</i>	<i>Margolisiella kabatai</i>
<i>Caelatura aegyptiaca</i>	<b><i>Urosporidium sp.</i></b>
<i>Unio abyssinicus</i>	<i>Haplosporidium, crescrere, H. pentafilum</i>



Mytilus edulis

**Haplosporidium sp.**



尾氏单孢子虫和微孢虫

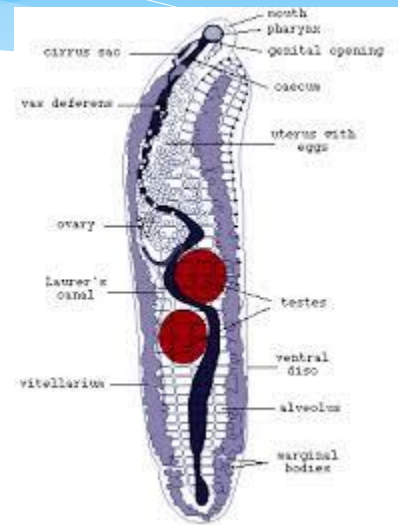
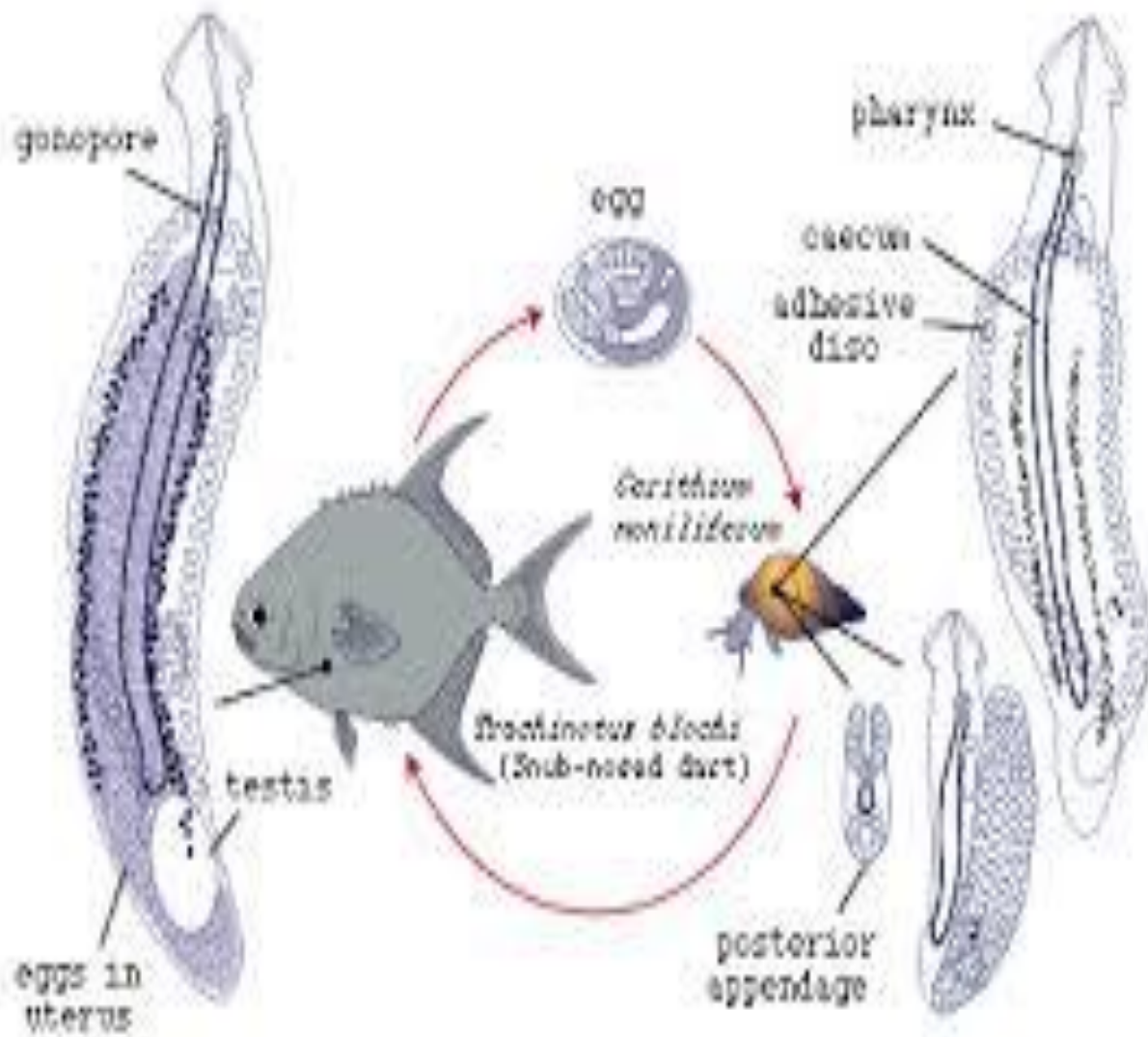
## Parasitic Trematods on mollusca

One of the most pervasive effects of parasitism is the impact of the **larval trematodes** in reproductive biology of molluscan intermediate hosts. **While, the primary site of infection in snails is usually the hepatopancreas,** they are frequently spread into the gonad and cause host castration.

The successful establishment of the larval trematodes within their hosts is associated with a remarkable **alteration of the host's metabolism, fecundity and survival.** **Apart** from the many constraints of parasite infection, the infected host **suffers a significant loss of energy for growth and reproduction.**

# Infection by adult trematods

- \* The Aspidogastrea is a small group of flukes belonging to the Trematoda, which comprises the two subclasses Aspidogastrea and Digenea.
- \* They are parasites of freshwater and marine molluscs and vertebrates (fishes and turtles).
- \* Maturation may occur in the mollusc or vertebrate host.
- \* There are no multiplicative larval stages of aspidogastreans in the mollusc host, as known from all digenean trematodes. In Egypt, a new species of adult trematode, *Aspidogaster niloticus* collected from the freshwater mussel, *Anodonta rubens*



## Infected of trematods larval stage

The larval stages of digenetic trematodes are harbouring the intermediate hosts of snails, as in *Schistosoma* and *Fasciola*.

The miracidia of these parasites approach and penetrate the snail hosts forming cercaria inside the redia or sporocysts. These cercaria invade the final hosts forming the adult stage of the trematode

## Snails

## Parasites

*Bulinus truncatus*

*Schistosoma haematobium*

*Biomphalaria alexandrina*

*Schistosoma mansoni*

*Onchomelania hupensis*

*Schistosoma Jabonicum*

*Lymnaea cailliaudi*

*Fasciola gigantica*

*Lymnaea truncatula*

*Fasciola hepatica*

*Segmentina hemisphaerula*

*Fasciolopsis buski*

*Bithynia fuchsiana*

*Clonorchis sinensis*

*Pirenella conica*

*Heterophyes heterophyes*



*Onchomelania hupensis*



*Segmentina hemisphaerula*



*Bithynia fuchsiana*



*Pirenella conica*



# mussel-trematode parasitism

<b>Hosts</b>	<b>Parasites</b>
<i>Unio batavus</i>	<i>Aspidogaster conchicola</i>
<i>Anodonta grandis</i>	<i>Aspidogaster conchicola</i> <i>Cotylaspis insignis</i>
<i>Helisoma trivolvis</i>	<i>Glypthelmins pennsylvaniensis</i>
<i>Helisoma anceps</i>	<i>Halipegus occidualis</i>
<i>Anodonta rubens</i>	<i>Rodella anodontae</i> <i>Aspidogaster niloticus</i>
<i>Lymnaea auricularia</i> <i>L. truncatula</i> <i>L. palustris</i>	<i>Hypoderaeum conoideum</i> <i>Echinoparyphium recurvatum</i> <i>E. albujerensis</i>

# parasitic Nematoda on mollusca

Considerably more is known about the relationship between molluscs and trematodes than between molluscs and nematodes.

The larval nematodes that utilize gastropods as intermediate hosts enter these hosts via the oral route and live in the lungs and body spaces of molluscs

<b>Hosts</b>	<b>Parasites</b>
<i>Arion empiricorum</i>	<i>Leptodera foecunda</i>
<i>Arion ater</i>	<i>Alloionema appendiculata</i>
<i>Helix pomatia</i>	<i>Aphelencus parietinus</i>
<i>Succinea putris</i>	<i>Mermis albicans</i>
<i>Limax flavus</i>	<i>Mullerius capillaris</i>
<i>Limax agrestis</i>	<i>Mermis nigrescens</i>
<i>Limax rufus, Arion ater</i>	<i>Leptodera angiostoma</i>
<i>Lymnaea vulgaris, L. ovata</i>	<i>Gordiun aquaticus, G. villoti</i>
<i>Bellamyia ingallsiana, Biomphalaria blabrata, Achatina fulica</i>	<i>Angiostrongylus cantonensis</i>



*Arion ater*



*Limax*



*Succinea putris*



*Helix*

Nematodes occurring in snails as belonging to six groups, based on differences in life cycle patterns as follows:

- \* **1-Normally free-living and plant parasitic nematodes that may pass through an animal's digestive tract.**
- \* **The association between snails and these nematodes is facultative and purely accidental. E.g., *Leptodera foecunda* in slime of the slug *Arion empiricorum*.**
- \* **2-Obligatory parasitic nematodes living in the host's digestive tract., members of the family Angiostomidae and Cosmocercidae live in intestine of *Limax rufus*, *Arion ater*.**

3- Nematodes with parasitic larvae occurring in the foot muscles of the host and with a free living adult stage.; *Alloionema appendiculata* in *Arion ater*.

4- Adult nematodes living in the genital organs of the host. for example, *Leptodera flexilis* in *Limax* sp.

5- Agamic nematodes and nematomorphs live in the lung and body spaces of the host *Mermis nigrescens* in *Limax agrestis*.

6- Parasitic nematodes of vertebrates, the larvae of which occur in snails.e.g. *Mullerius capillaris*, a parasitic of sheep with its larvae reported from *Limax cimereus*.

\* **As a rule, larval nematodes occurring in the tissue of molluscs are encapsulated, and the capsule is usually comprised of host leukocytes.**

\* For example, the larvae of *A. cantonensis* encapsulated in the foot muscles of *A. fulica*, and the capsules are comprised of host myofibers that have become fused and infiltrating leukocytes

# Parasitic Water mites on Mollusca

- \* Water mites are true parasites on molluscan hosts. Adults and larval stages of many species of the genus *Unionicola* are parasitizing the molluscan hosts as mussels and snails

<b>Hosts</b>	<b>Parasitic mites</b>
<i>Anodonta anatina</i>	<i>U. aculeata</i>
<i>Unio pictorum</i>	<i>U. bonzi</i>
<i>Cyclonaias tuberculata</i>	<i>Unionicola. causeyae,</i>
Freshwater mussels	<i>U. crassipes</i>
Unionodae	<i>U. hankoi</i>
<u><i>Anodonta rubens</i></u>	<i>Unionicola anodontae</i> <i>Unionicola niloticus,</i> <i>U. palpatus</i>
<i>Caelatura aegyptiaca</i> <i>Unio abyssinicus</i>	<i>U. tetrafurcatus</i> <i>U .difurcatus</i>



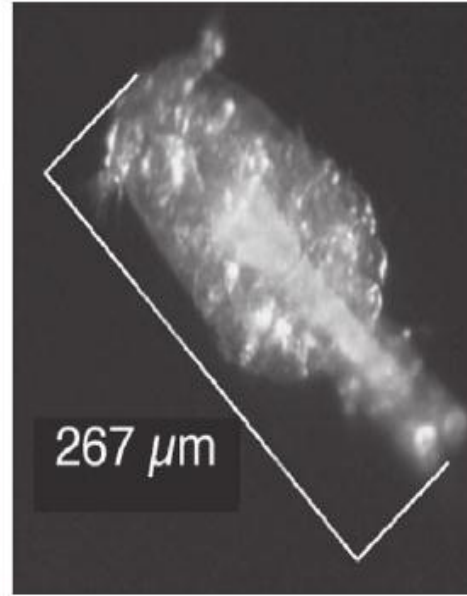
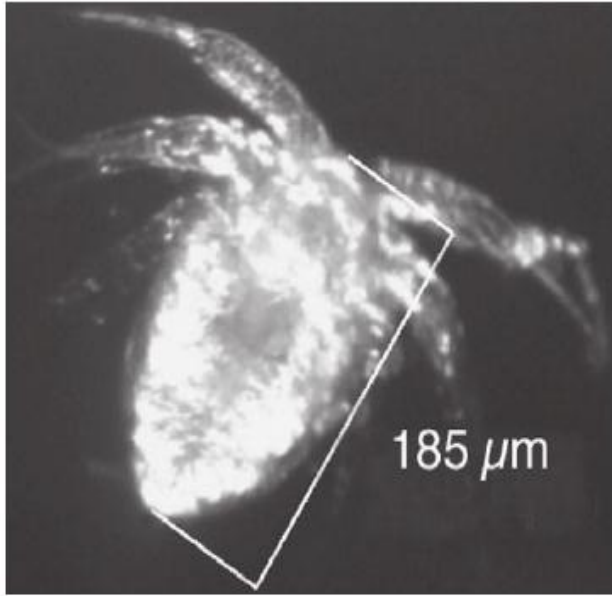
## 5- Crustacea (copepod; Mytilicolosis)

- \* ***Mytilicola intestinalis* is a copepod, infected *Mytilus edulis*, *Mytilus galloprovincialis*, *Ostrea edulis* and a wide range of other marine bivalves. Juvenile mussels are rarely infected.**
- \* Levels of infection appear directly correlated with size. There is evidence that growth in mussels, suffering *Mytilicola* infections, is **severely retarded**. Populations chronically affected with *M. intestinalis* frequently show prevalence of 100% infection and intensities of over 30 copepods per mussel. The effect of such infection appears related to adverse growing conditions rather than to the actual pathogenicity of the copepod. It occurs in Europe from Denmark to Italy.

\* Histological evidence indicates that *M. intestinalis* causes local metaplastic changes in the gut epithelium involving the replacement of normal ciliated columnar cells with non-ciliated cuboidal cells.

The copepod feeds on the gut contents of the host and not on host tissues

determined that juvenile stages of the parasite cause most damage to the host, due in part to their presence in the ramifications of the hepatopancreas.



Red worm disease

