Marine parasitology

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Definitions

- Symbiosis ("living together")
  - France: beneficial relationship for both partners
  - US: all kind of associations
- Phoresy: transport
- Mutualism: benefit for both partners
- Commensalism: benefit for one partner, nothing for the other
- Parasitism: the parasite lives at the expend of the host, then it is potentially deleterious to the host, and metabolically depends from it

Prevalence: fraction of infected hosts by a given parasite species at a given moment
Intensity: number of parasite individuals of a given species in each infected host individual
Mean intensity: total number of individuals of a particular species in a sample of host species/number of infected individual hosts in the sample
Abundance: total number of individuals of a particular species in a sample of host species/number of individual hosts in the sample

Parasitism

- Benefit for the parasite, cost for the host
- Parasites localisation
  - Ectoparasite: external. e.g.: surface, scales, gills, opercules, mouth, ...
  - Endoparasite: internal. e.g.: digestive track, organs, muscles, ...
Many adult parasites display few pathogenicity in the natural environment: not “interesting” from an evolutionary point of view.

Aquaculture conditions modify the natural equilibrium and lead to pathogenicity
- High host concentration
- Perturbation of trophic chains
- Changes in behaviour (contact, ...)
- Introduction of alien species

Larval stages are often pathogenic, especially when a trophic transfer is needed
That may lead to an active modification of host behaviour

Platyhelminthes
- Flat
- Acoelomates
- Bilaterians
- No anus
- No respiratory or circulatory system
- Hermaphrodites in general
Monogeneans

- Ectoparasites: gills, surface
- 200 µm to 1 cm
- All aquatic: mostly on fish, cephalopods, amphibians, reptiles,...

Anatomy

- Direct life cycle
  - Adult
  - Egg
  - Larvae = oncomiracidium

Monopisthocotylea
- Simple haptor
- Small (< 1 mm)
- Graze epithelium: lesions

Polyopisthocotylea
- Complex haptor
- Large (> 1 mm)
- Hematophagous
Examples

Dactylogyridae
- *Dactylogyrus* spp., ...
- Cyprinidae (carp)
- Eel: *Pseudodactylogyrus* spp.

Gyrodactylidae
- *Gyrodactylus* spp., ...
  - Polyembryony: no mobile larvae, vertical transmission via contact
  - Many hosts (gobies, ...)
  - Highly specific, > 20000 species

Capsalidae
- *Benedenia*
  - Mugilids

Diplectanidae
- *Furnestinia echeneis* on *Sparus aurata*

Diplectanum aequans on *Dicentrarchus labrax*

Microcotylidae
- *Microcotyle* on *Sparus aurata*

Cestodes

- Adults all endoparasites in Vertebrate guts
- Sometimes very long (several m)
- No digestive track, no digestive enzymes
- Hermaphrodites, generally protandrous
- Numerous in fish (IH or DH): abundance, species - larvae and adults
- IH: crustaceans, molluscs, fish
- Sometimes transmittable to human (*Diphyllobothrium*, *Bothriocephalus*)
Anatomy

Indirect life cycle

Adult

Definitive host

Intermediate host 1

Coracidium

Intermediate host 2

Larvae

Plecocercoid

Example

- Bothriocephalus (flat fishes)
- Mechanical blocking
- Nutrients diversion

Bothriocephalus

Digeneans

- Endoparasites
- 1 mm to a few cm
- Larval or adult stages in predators: fish, cephalopods, ...
- Larvae in molluscs
- Specificity for DH often low
Anatomy

Indirect life cycle

Adult
Definitive host

Larvae
= miracidium

Intermediate host 1
= mollusc

Metacercariae

Intermediate host 2
= nematode

Cercariae

Egg

Spargyra

Example

Cainocreadium sp.: bass (D. labrax), dentex (D. dentex)

Derogenes varicus

Very high number of DH: fish, cephalopods

One of the most largely spread animal

Opecoeloides furcatus

DH: mullet (Mullus surmuletus)
Aspidogasters

Aspidobothrea = Aspidogastrea = Aspidocotylea
Facultative or obligatory in molluscs, fish, turtles
Not highly adapted to parasitism
No economically or medically important species
Few species

Anatomy

Cycle
Cotylocidium mobile larvae
Direct: molluscs
Indirect
Add a Vertebrate DH
Low specificity
No pathogenicity

Nematodes

Endoparasites
Separate sexes
Pseudocoelomates
Many species and individuals, most free living
Hosts in all taxonomic groups
Some zoonoses: anisakids, capillarids, gnathostomatids
Morphologically homogeneous
Anatomy

Direct or indirect life cycle
- 4 moltings and 4 larval stages

Examples
- *Anguillicola crassus* (in swim bladder)
  - DH: Eel; IH: Crustacean

Anisakis
- Many IH (fish, cephalopods, ...)
- DH: marine mammals
- Zoonosis: anisakiasis
Acanthocephalans

- Endoparasites
- Several cm
- Separate sexes
- Pseudocoelomates: no gut (absorption via tegument), no excretory system
- DH: vertebrates
- Many fish parasites, some in crustaceans
- Adults in intestine, larvae in organs

Anatomy

Indirect life cycle

- Adult
- Definitive host
- Intermediate host 1
- = arthropod
- Cystacanth Acanthella Acanthocephalus
Manipulation of IH behaviour

Cystacanth

Pomporynchus laevis
Adult
in an amphipod (IH)

HD: Fish

Crustaceans

Ectoparasites
Large size: often pathogenic
Morphology sometimes highly modified compared to free living relatives
Direct life cycle in general

Copepods

Many species
Often pathogenic
Highly modified morphology
Direct life cycle
Larval planctonic stages: nauplius, chalimus
DH: fish, cephalopods, ...

Ergasilidae (Ergasilus): mobile
Sarcotaces: cysts under the skin
Lernaeida
Caligidae
Penellidae (Lernaeocera branchialis): Gadidae, IH
Lernaeopodidae: Salmincola
Branchiura

- Argulides: Argulus
- DH: fish, cephalopods
- Direct life cycle
- No nauplius
- Hematophagous
- Can move
- Viruses transmission

Isopods

- Cymothoidae
  - Fish, cephalopods
  - Large size (several cm)
  - Sexual dimorphism: semi-free males
  - Protandrous
  - Pathogenic: lesions on skin

Gnathiidae

- Parasites larvae (praniza)
- Hematophagous
- Free living benthic adults

Bopyridae

- Parasites of shrimp
- In branchial cavity: problems with molting
- High sexual dimorphism
Hirudinids

- Annelids: leeches
- Ectoparasites
- Large (several cm)
- Hermaphrodites
- Hematophagous
- Fresh and marine water

Anatomy

- Direct life cycle
  - Reproduction on host or not, eggs laid in the environment
  - Temporary (on host only to feed) or half-permanents (off hosts only to lay eggs)

Pathogenicity

- Low direct pathogenicity (half-permanents), secondary infections
- Disease transmission (virus and bacteria): temporary
  - Virus (carp, salmon)
  - Bacteria (carp)
  - Protozoans: Trypanosomes