

## Parasitic metazoa

### Platyhelminthes - flatworms

They tend to be flat, although many of them are fusiform or even filiform. They may be segmented or unsegmented and they all are equipped with characteristic attachment organs.

#### Key to classes of *Platyhelminthes*

1. Ectoparasites; one posterior attachment organ, with one or more pairs of median hooks and varying numbers of marginal hooks and/or clamps ..... *Monogenea*
  - Endoparasites; attachment organs not as above ..... 2
2. One attachment organ, armed with hooks and/or suckers (some without this organ). Gut absent. Body ribbon-like, segmented or unsegmented ..... *Cestoda*
  - Two sucker-like attachment organs. Gut present, usually bifurcated. Body unsegmented, flat to fusiform ...*Trematoda*

#### Class *Monogenea*

The monogeneans are hermaphroditic flatworms parasitic mostly on or in fishes and some other aquatic or amphibious cold-blooded vertebrates, occasionally on aquatic invertebrates. They are most commonly found in the gill chamber, on skin, in buccopharyngeal cavity, or in other organs communicating directly or indirectly with the exterior (nostrils, cloaca, urinary bladder, etc.). Their development is without intermediate hosts. The chief attachment organ (opisthaptor) is posterior, more or less discoid, muscular, provided with paired or unpaired anchors and a number of marginal hooks or with muscular suckers or clamps without or with supporting sclerites and anchor complexes. Accessory adhesive organs may be present in form of armed plaques, lappets or appendices.

#### Key to subclasses of *Monogenea*

- 1 Opisthaptor with 1–3 pairs of anchors and with 7–8 pairs of marginal hooks, without clamps .....*Polyonchoinea*
  - Larval opisthaptor mostly with 5 pairs of marginal hooks. Opisthaptor of the adult is developed as suckers or clamps supported by sclerites or a combination of clamps and anchor complexes .....*Oligonchoinea*

The most frequent *Polyonchoinea* infecting freshwater fishes are represented by numerous genera and species of 4 families (3 orders).

#### Key to orders and families of *Polyonchoinea*

- 1 (6) Oviparous
- 2 (5) Opisthaptor with 7 pairs of marginal hooks and with 1–2 pairs of anchors .....Order *Dactylogiridea*
- 3 (4) Opisthaptor with 7 pairs of marginal hooks and with 1 pair of anchors .....Family *Dactylogiridae*
- 4 (3) Opisthaptor with 7 pairs of marginal hooks and with 2 pairs of anchors .....Family *Ancyrocephalidae*
- 5 (2) Opisthaptor with 8 pairs of marginal hooks and with 2 pairs of anchors .....  
Order *Tetraonchidea* Family *Tetraonchidae*
- 6 (1) Viviparous .....Order *Gyrodactylidea* Family *Gyrodactylidae*

The most frequent Oligonchoinea infecting freshwater fishes are represented by some genera and species of 5 families (2 orders).

**Key to orders and families of *Oligonchoinea***

- 1 (2) Opisthaptor with 3 pairs of sessile suckers, each provided with a large curved sclerite ending in a hook and a prominent opisthaptoral appendix bearing 3 pairs of anchors.....Order *Diclobothriidea* Family *Diclobothriidae*
- 2 (1) Opisthaptor with 4 or more pairs of clamps and with 1–2 pairs of anchors on terminal lappet.....Order *Mazocraeidea*
- 3 (4) Opisthaptor with 4 pairs of clamps and with 2 pairs of anchors.....Family *Mazocraeidae*
- 4 (3) Opisthaptor with 4 pairs of clamps and with 1 pair of anchors.
- 5 (6) Two adults permanently fused in form of letter.....Family *Diplozoidae*
- 6 (5) Each adult exists individually
- 7 (8) Testes numerous, gill parasites of *Salmonidae*.....Family *Discocotylidae*
- 8 (7) Testis one, gill parasites of *Cyprinidae*.....Family *Octomacridae*

**Class *Cestoda***

Tapeworms (Fig. 12) represent a platyhelminth group with exclusively endoparasitic pattern of life. They mostly parasitize in the intestine of vertebrates. Their extreme adaptations to endoparasitism resulted in complete loss of digestive system and an increase in reproductive capacity that often

stagger the imagination. A total of 4,000 species of cestodes have been described; many of them are parasitic in fishes either as adults or as larvae.

Although considerable variation of morphology occurs between different orders of tapeworms, there are underlying similarities that unite the orders into the class *Cestoda*.

The tapeworm body usually consists of a chain of segments called proglottids, each of which contains one or more sets of reproductive organs. The proglottids are continuously produced by a process of asexual budding. The entire body formed by proglottids is called a strobila, and a segmented strobila is said to be polyzoic. In some groups, particularly in fish cestodes, the body consists of a single segment, and is then said to be monozoic. At the anterior end a holdfast organ or scolex is usually found, that is the principal means of locomotion of these animals. Depending on the group, the scolex may be provided with suckers, grooves, hooks, spines, glandular areas, or combination of these.

All fish cestodes are hermaphroditic and their life cycle includes at least one intermediate host, mostly invertebrates (oligochaetes, copepods, amphipods, etc).

#### **Key to orders of fish cestodes**

- 1 (2) Strobila with no internal segmentation; one set of reproductive organs present  
.....*Caryophyllidea*
- 2 (1) Strobila with internal segmentation; more than one set of reproductive organs present.
- 3 (4) Scolex with no true suckers, bothria, bothridia, or tentacles; no external segmentation  
.....*Spathobotriidea*
- 4 (3) Scolex with one of the holdfast types listed above (3); external segmentation usually distinct.
- 5 (6) Scolex with two bothria .....*Pseudophyllidea*
- 6 (5) Bothria absent; scolex armed with four rounded suckers .....*Proteocephalidea*

#### **Class Trematoda**

Fish trematodes are endoparasitic. They possess bilaterally symmetrical, dorsoventrally flattened, unsegmented bodies, usually oval or lanceolate. The majority of trematodes fall into the range of 1–30 mm. Trematodes are commonly equipped with two attachment organs, the oral sucker at or near the body's anterior end and the ventral sucker, or acetabulum, the position of which varies from near-anterior to near-posterior, with all positions in between. Some species lack one of suckers or even both. Most fish trematodes are hermaphroditic.

The life cycles of trematoda involve more than one (often three) hosts and include several morphologically different developmental stages. The first intermediate hosts are usually molluscs, which release motile larval stages - cercariae. Freshwater fish may serve as the second intermediate

hosts of the next developmental stages (metacercariae) or as definitive hosts. Metacercariae are encysted in various inner organs and tissues, adults are localized mostly in the alimentary system, less often in excretory or blood-vascular systems and in body cavities.

### ***Diplostomatidae***

Body divided into two parts; forebody leaf-shaped, hindbody considerably smaller. Oral sucker small, terminal, anterior end provided sometimes with two pseudosuckers. Acetabulum postequatorial, holdfast organ situated in posterior part of forebody. Metacercariae motile, unencysted, localized in eyes (*Diplostomum*, *Tylodelphys*), or encysted in brain, skin, muscles and other organs of many freshwater fish (*Neodiplostomum*, *Posthodiplostomum*). Some representatives (*Diplostomum* spp.) are serious pathogens causing even death of highly infected fish.

### ***Bucephalidae***

Gasterostomatous trematodes without oral sucker, with rhynchus as adhesive organ at anterior end. Pharynx and oesophagus present. Intestine simple, saccular; no acetabulum. Members of the genera *Bucephalus*, *Bucephalopsis*, *Rhipidocotyle*, *Prosorhynchus* are common parasites of freshwater fish.

### ***Sanguinicolidae***

Trematodes of lanceolate body shape, living in blood-vascular system; usually without suckers. Pharynx absent, intestine X- or H-shaped. Thin-shelled eggs, without operculum, sometimes with lateral projection (*Sanguinicola*). Some species can cause serious damage to fish in aquaculture.

### **Nematoda - roundworms**

The nematodes (Fig. 14) represent a large group of metazoan invertebrate animals. They are noted for the elongate, cylindrical body covered with strong protecting cuticle that usually has fine transverse striations. The mouth opening is usually surrounded by lips and cephalic papillae, sometimes a sclerotized buccal capsule occurs. The digestive tube is formed by the oesophagus, often subdivided in two distinct parts, the intestine and the rectum. The sexes are separated. The male tail is sometimes provided with caudal alae, genital papillae and usually one or two sclerotized spicules are present. They are free-living or parasitic in animals and plants. From about 16,000 described species, about 40 % are animal parasites.

Nematodes belong to the most frequent parasites of freshwater fishes, some of them being the agents of serious fish diseases. In addition to adult forms, some nematode species occur in fishes only as larvae. The definitive hosts of these species are then various piscivorous vertebrates (fishes, reptiles, birds, mammals), whereas the fish harbouring these larvae serves as the intermediate or the paratenic host. The development of fish nematodes is either direct or, more frequently, with the participation of an obligate intermediate host (usually an invertebrate).

### Key to subclasses of *Nematoda* parasitic in vertebrates

1. Eggs with plug at either pole; males with one spicule or spicule absent; oesophagus cylindrical or with oesophageal glands free in pseudocoel stichosome; phasmids absent.....  
.....*Adenophorea*
- Eggs without polar plugs, rarely operculate at one pole, or hatching in uterus; males usually with two spicules, exceptionally spicule one or absent; oesophagus never in form of stichosoma; plasmids present .....*Secernentea*

### *Adenophorea*

*Adenophorea* are represented in fishes only by one order *Enoplida*; only its superfamily *Trichuroidea* includes adults from fishes, while *Dioctophymatoidea* contains some genera (*Dioctophyma*, *Eustrongylides*) parasitic in fishes only as larvae.

### Key to families of *Trichuroidea*

- 1 Complete digestive tract present, posterior region of female cylindrical .....*Capillariidae*
- Digestive tract incomplete; posterior region of female expanded to form vesicle .....*Cystoosidae*

### **Acanthocephala - spiny-headed worms**

Acanthocephalans belong to one class and they are all parasitic. The body shows three externally recognizable regions: the trunk, the neck and the retractable proboscis armed with a set of posteriorly pointing hooks the number, size and arrangement of which are of taxonomic importance. The proboscis functions to anchor the worm in place more or less permanently, by penetrating the host's intestinal wall. The trunk is a sac-like structure, subcylindrical, usually with pseudosegmentation. The digestive tract is absent. The sexes are separate. Their development involves an invertebrate intermediate host.

Many acanthocephalan species of different genera and families are parasitic in both marine and freshwater fishes all over the world. The forms parasitizing freshwater fishes belong to 3 orders.

### Key to orders of freshwater fish acanthocephalans

- 1 Cement glands syncytial; cuticle nuclei giant.....2
- Cement glands in form of several compact formations; cuticle nuclei usually small.....*Palaeacanthocephala*

2 Trunk with cuticular spines.....*Gyracanthocephala*

- Trunk without cuticular spines.....*Neoacanthocephala*

### **Order *Gyracanthocephala***

*Pallisentis ophiocephali* belonging to the family *Quadrigyridae* parasitizes mainly fishes of the family *Channidae* in tropical Asia. It develops probably through copepods.

### **Order *Neoacanthocephala***

*Neoechinorhynchus rutili* of the family *Neoechinorhynchidae* is parasitic in many fish species of different families (mainly cyprinids) in Palaearctic Eurasia. Its development is through ostracods.

### **Order *Palaeacanthocephala***

*Acanthocephalus anguillae* of the family *Echinorhynchidae* is a frequent parasite of cyprinids and some other fishes in Europe. Its intermediate host is a freshwater isopod *Asellus aquaticus*.

*Pomphorhynchus laevis* of the family *Pomphorhynchidae* is a common parasite of cyprinids and other fishes in Europe. Its intermediate hosts are various species of freshwater gammarids.