

INTRODUCTION TO HELMINTHOLOGY

characteristic, classification;
DIGENEA (TREMATODA) – morphology, classification
and life cycles. Order ECHINOSTOMIDA.

Requirements for passing the course / credit

- 100% active attendance of the students at practical lessons. One failure to attend a practice (documented by a doctor) can be justified by the teacher.
- Successful completion of continuous checks of study (student **must obtain at least 51%**) - one test during the semester with a score of 100 points and evaluated according to Art. 20 point 4 of the Study Program of the UVLF in Košice on the issue of Helminthology (practical lessons).
- Attendance at lectures 60%.

Compensation of practical exercises: in agreement with the teacher, in the 13th week of SS.

Consultation: in agreement with the teacher (depending on teaching and research activity).

Ongoing evaluation

Credit test from Helminthology, **15th April 2021**, 10th week of SS.

Final rating: At the end of the semester, credit is entered into the AIS system; **Practical and oral exam.**

Practical exam is necessary to continue with oral exam. In the event of an unfavourable epidemiological situation, the practical test is omitted; the questions will be reflected in the test. Similarly, the oral examination in the event of an unfavourable situation will be in writing form (questions in the form of a choice from several options or refilling).

RECOMMENDED READING

1. Deplazes P., Eckert J., Mathis A., von Samson-Himmelstjerna G., Zahner H.: **PARASITOLOGY IN VETERINARY MEDICINE**. Wageningen Academic Publishers, 2016, 653 s. ISBN 978-90-8686-274-0.
2. M. Taylor, B. Coop, R. L. Wall: **VETERINARY PARASITOLOGY**, 2007, Blackwell publishing
3. Soulsby, E.J.L.: **HELMINTHS, ARTHROPODS AND PROTOZOA OF DOMESTICATED ANIMALS**. Bailliere Tindall, 1986.
4. Unquert, G.M. et al.: **VETERINARY PARASITOLOGY**. Longman Scientific & Technical, 2000
5. Forey W.J.: **VETERINARY PARASITOLOGY**. Reference manual. Fifth Edition Iowa State Press, 2001, 235s ISBN 0-8138-2412-2.
6. Letková, Váňa. **INTRODUCTION TO VETERINARY HELMINTHOLOGY - Diagnostic Manual**. Rec. Monika Halánová. 1. vyd. Košice - UVLF, 2016, 216 s. ISBN 978-80-8077-488-2
7. Letková, V., Goldová, M., Čisármánová, G.: **HANDBOOK FOR THE DIAGNOSIS OF PARASITES**, 1996, Part I. Protozoology
8. Letková, V., Goldová, M., Čisármánová, G.: **HANDBOOK FOR THE DIAGNOSIS OF PARASITES**, 1996., Part III, Arachnoentomology



SCHEME OF THE LECTURES. VIII. SEMESTER (2 h)

1. **INTRODUCTION TO HELMINTHOLOGY**, characteristic, classification, DIGENEA (TREMATODA) – morphology, classification and life cycles. The main features of families.
2. **ASCARIDOSIS, DICROCOELOSIOS, PARAMPHISTOMOSIS** – morphology, location, prevalence, life cycles, epidemiology, pathogenesis and clinical signs, pathology, diagnosis, treatment and control.
3. **OTHER TREMATODOSSES** of human and veterinary importance (genus *Schistosoma*, *Paragonimus*, *Opisthorchis*, *Metagonimus*, *Prostogonimus*, etc.) – morphology, location, life cycles, prevalence, epidemiology, pathogenesis, pathology, diagnosis, methods of prevention and control.
4. **CESTODA** – morphology, classification and life cycles. (Cyclophyllida and Pseudophyllida), *Diphyllobothrios*, *spirostrosis* and *sparganosis* of human and carnivores – morphology, life cycle, epidemiology, pathogenesis and clinical signs, pathology, diagnosis, methods of treatment and control.
5. **TAPEWORM DISEASES OF MAN** (fam. Taeniidae, Hymenolepididae) – the main species, morphology, life cycles, prevalence, epidemiology, pathogenesis and clinical signs, pathology, diagnosis, treatment and control. Diseases caused by larval cestodes: cysticercosis and other metacestodosis: hydatidosis, alveococcosis, coenurus, etc.
6. **TAPEWORM DISEASES OF DOGS** (fam. Taeniidae, Dipylidiidae, Mesocestoididae) – the main species, morphology, life cycles, prevalence, epidemiology, pathogenesis and clinical signs, pathology, diagnosis, treatment and control.
7. **TAPEWORM DISEASES POULTRY AND RODENTS** (fam. Hymenolepididae, Davaineidae, Dilepididae) – the main species according to the hosts, morphology, life cycles, epidemiology, pathogenesis, pathology, diagnosis, treatment and control.
8. **NEMATODA** – morphology, classification and life cycles. The main features of orders, RHABDITIDA, **OSTYURIDA** – oxyuriases (horse, rabbit, human), morphology, life cycle, epidemiology, prevalence, pathogenesis and clinical signs, pathology, diagnosis, treatment and control.
9. **ASCARIDA** – ascaridosis, (horse, pig, cattle, carnivores, poultry), anisakidosis – the main species; morphology, life cycles, epidemiology, prevalence, pathogenesis and clinical signs, pathology, larva migrans (MAP, LMO), diagnosis, treatment, control.
10. **STRONGYLIDA** – GI strongylidosis (ruminants, horses, pig, carnivores, poultry) – the main species according to the hosts, morphology, life cycles, epidemiology, prevalence, pathogenesis and clinical signs, pathology, diagnosis, treatment and control.
11. **STRONGYLIDA** – lung strongylidosis (cattle, sheep, pig, horse, carnivores, rabbit, poultry) – the main species, morphology, life cycles, epidemiology, prevalence, pathogenesis and clinical signs, pathology, diagnosis, treatment and control.
12. **ENDOPLEIDA** (Trichurida), **SPHURIDA**, **FLUIDA** – characteristic, the main species, morphology, life cycles, epidemiology, prevalence, pathogenesis and clinical signs, pathology, diagnosis, treatment and control.
13. **ACANTHOCEPHALA** – morphology, classification and life cycles. *Macronchtherynchus*, *Polymorphus* – morphology, life cycle, epidemiology, pathogenesis and clinical signs, pathology, diagnosis, treatment and control.

SCHEME OF THE PRACTICAL LESSONS: VIII. SEMESTER (3 h)

1. **TREMATODA** – morphology and classification. The main morphological features of Digenea and their developmental stages.
2. **CESTODA** – morphology and classification. Cyclo- and Pseudophyllida, larval stages – metacestode. Morphological features of main families.
3. **NEMATODA** and **ACANTHOCEPHALA** – morphology and classification. The main morphological features of orders.
4. **MICROSCOPY** and **MICROMETRY** of helminths eggs, morphological features of eggs.
5. **QUALITATIVE AND QUANTITATIVE METHODS** for intravital diagnosis of parasitic diseases. Flotation methods, McMaster methods.
6. **SEDIMENTATION** and **LARVOSCOPIE METHODS**. Diagnosis of lungworms. Faecal cultures methods. Differential dg. of L₁ of lung and L₃ of gut Strongyles.
7. **LABORATORY DIAGNOSIS OF ENDOPARASITES IN RUMINANTS**. List of endoparasites of ruminants and their diagnosis. Morphology of eggs and cysts.
8. **LABORATORY DIAGNOSIS OF HORSES AND PIGS ENDOPARASITES**. List of endoparasites of horses and pigs and their diagnosis. Morphology of eggs and cysts.
9. **LABORATORY DIAGNOSIS OF ENDOPARASITES IN CARNIVORES**. List of endoparasites in carnivores and their diagnosis. Morphology of eggs and cysts.
10. **LABORATORY DIAGNOSIS OF POULTRY, RODENTS AND RABBITS ENDOPARASITES**. List of endoparasites in the above mentioned hosts and their diagnosis. Morphology of eggs and cysts.
11. **DIAGNOSIS OF TRICHINELLOSIS**. Collection of muscle samples. Microscopic examination, digestive methods according to the EU legislation. Morphology of cysts and larvae of *Trichinella* spp.
12. **TECHNIQUES FOR POST MORTEM DIAGNOSIS OF PARASITIC DISEASES**. Techniques for helminthological necropsy in mammals and birds.
13. **REPETITION, CONSULTATION AND COMPENSATION**.

QUESTIONS OF PARASITOLOGY

(Every question includes morphology, location, main species, geographical distribution, epizootology, epidemiology, the life cycle, pathogenesis and clinical signs, pathology, diagnosis, treatment and control of a parasite.)

PRACTICALEXAM

1. Coprological examination of ruminants – flotation methods.
2. Coprological examination of ruminants – sedimentation methods.
3. Coprological examination of ruminants – larvoscopy.
4. Coprological examination of horses.
5. Coprological examination of pigs.
6. Coprological examination of carnivores.
7. Coprological examination of poultry.
8. Coprological examination of rabbits and hares.
9. Coprological examination of rodents.
10. Diagnostic methods of sarcosystosis in IH.
11. Quantitative concentration methods.
12. Diagnostic methods of cryptosporidiosis.
13. Diagnostic methods of trichinellosis.
14. Diagnostic methods of ruminants blood parasites.
15. Diagnostic methods of carnivorous blood parasites.

Parasites of large intestine of ruminants and pigs (Chabertia, Oesophagostomum)
 Anisostomum and Ichthyophthirius of poultry
 Implants of pigs
 Hemaphysoids of camions (BMC)
 Hemaphysoids of camions
 GI trichostomylids of ruminants, rabbits and hares (Trichostrongylus, Nemodirus, Marphagia, Haemonchus)
 Bovine, and ovine ostertagias
 Lung strongylids of cattle (Cyathostomum)
 Lung strongylids of small ruminants (Cyathostomus, Marfesia, Marfesia, Cyathostomus, Brucium)
 Lung strongylids of pigs (Metastomum)
 Lung strongylids of camions (Camponema, Camponema)
 Lung SPHINX: Spinoxicon: Spinoxicon of pigs
 Relations of ruminants
 Other species: Foraminifera, Hemaphys, Diatoma, Chabertia, Oesophagostomum
 Order PLASMODIA: Diptera: Diptera of dogs and cats
 Bovine and porcine ostertagias: Ostertagia, Paratuberculosis, Strongylus, Strongylus, Strongylus, Strongylus
 Parasites of man (Chabertia, Brugia, Chabertia, Haemonchus, Haemonchus)
 Order Diptera: Trichostomylids
 Trichostomylids and Capillaria, Trichostomylids and Capillaria of animals
 Hemaphys, classification, and the life cycle of ACANTHOCEPHALA
 Hemaphys and Hemaphys of aquatic birds
 Mammaltrichostomylids of aquatic birds

2

Prepatent period: The time interval from the ingest of the parasite to the emergence of the propagative stages of the parasite (cysts, oocysts, eggs, larvae) from the host organism. It is **species-specific**.

Incubation time: The time from the infestation of the parasite (pathogen) into the host to the appearance of the initial clinical signs of the disease.

Patent Period: Is the time interval indicating an active infection. By this is meant the time during which the parasite is **clinically detectable in the host**.

It can also mean the life span of a parasite in a host or the time during which the parasite is capable of producing eggs, larvae, cysts or oocysts.

Nomenclature !!!

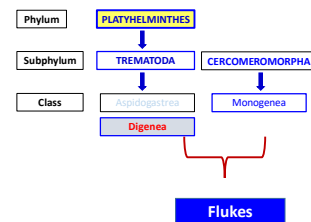
Disease – „**parasitosis**“ (-osis; e.g. trichinello**sis**)

„**Pathogen**“, which causes parasitosis = **PARASITE**
(e.g. *Trichinella spiralis*)

General characteristics of phylum

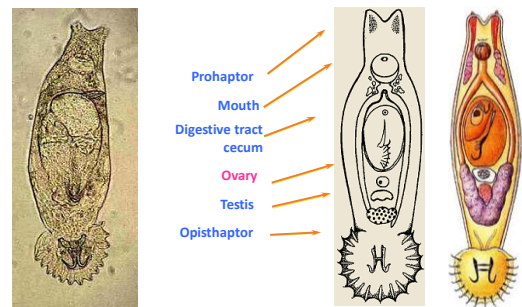
PLATYHELMINTHES

- cca 20.000 species
- Also "flat worms"
- They live in marine, freshwater conditions and also on land
- Dimensions: from mm to more than 20 m
- Body bilaterally symmetrical
- **Dorsoventrally flattened**
- Called: Acoelomate **body cavity is missing**
- Triploblastic - 3 different germinal leaves
- Diffusion breathing
- Digestive system **incomplete**
- Excretory system - protonephridial type with so-called **flame cells**
- The first known so-called **Cephalization** - cranial nerve ganglion
- Most **hermaphrodites** (exception - family Schistosomatidae)
- Life cycle: **indirect**, via intermediate hosts (biohelminths)



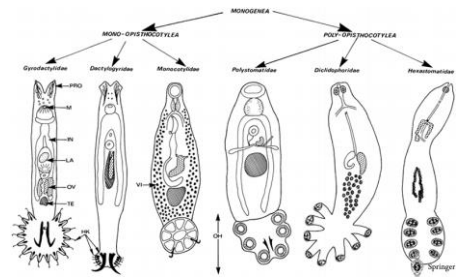
Class: Monogenea

- About 1.100 species
- **Ectoparasites on the skin** or gills of fish, amphibians, reptiles, cetaceans or cephalopods;
- The life-cycle is **direct, with a single host**.
- They are attached to the host's surface by a characteristic **opisthaptor** which is **species-specific** and provided with hooks and hooklets.
- Genera: *Gyrodactylus*, *Dactylogyrus*, *Diplozoan*





Monogeneans have a direct life cycle in a single host.



Class: Digenea

- About 11.000 species.
- All have complex life cycles, involving **one or more intermediate hosts**, the first of which is always a **mollusc**, which is **usually aquatic**.
- As adults they found in most vertebrates groups, including fish, amphibians, reptiles, birds, and mammals, acting as **final (definitive) hosts**, where they may give rise to **highly pathogenic infections**.
- They may be located in most of the internal organs (**lungs, bladder and blood stream**).
- Although the majority are found in the **gastrointestinal tract**, or closely associated organs such as the **bile duct and liver**.

Class: DIGENEA

Order	Family	Genus
ECHINOSTOMIDA	Fasciolidae	<i>Fasciola</i> , <i>Fascioloides</i> , <i>Fasciolopsis</i> ,
	Echinostomatidae	<i>Echinostoma</i> , <i>Euparyphium</i> , <i>Echinoparyphium</i> , <i>Hypoderaeum</i> , <i>Philophthalmus</i> , ...
	Paramphistomidae	<i>Paramphistomum</i> , <i>Calliphoron</i> ,
AMPHISTOMIDA	Gastrophilidae	<i>Calliphoron</i> , <i>Gigantostyle</i> , <i>Orthocotellum</i>
	Gastrothylacidae	<i>Gastrothylax</i> , <i>Carmynerius</i> , <i>Fischöderius</i>
	Dicrocoeliidae	<i>Dicrocoelium</i> , <i>Eurytrema</i> , <i>Platynosomum</i>
PLAGIORCHIDA	Prosthogonimidae	<i>Prosthogonimus</i>
	Troglostrematidae	<i>Collyricium</i> , <i>Troglostrema</i> , <i>Nanophyetus</i>
	Paragonimidae	<i>Paragonimus</i>
OPISTHORCHIDA	Heterophyidae	<i>Heterophyes</i> , <i>Metagonimus</i> , <i>Apophyllus</i>
	Opisthorchidae	<i>Opisthorchis</i> (syn. <i>Clonorchis</i>), <i>Metorchis</i>
STRIGEIDIDA	Schistosomatidae	<i>Schistosoma</i> , <i>Bilharzia</i> , <i>Trichostrongylus</i> , <i>Orientobilharzia</i> , <i>Ovithobilharzia</i> , <i>Heterobilharzia</i> , <i>Austrobilharzia</i>
	Strigidae	<i>Apotemon</i> , <i>Cotylurus</i> , <i>Parastrius</i> , <i>Strigea</i>
	Diplostomidae	<i>Diplostomum</i> , <i>Alaria</i>

Morphology

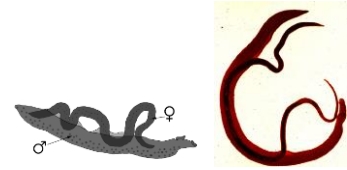
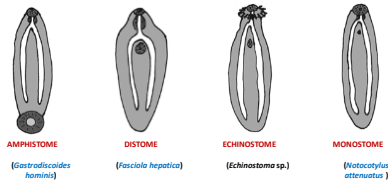


Significant **suckers**, usually oral and abdominal (**acetabulum**) suckers, which have a predominantly **fixative function**, are noticeable on the body surface.



The Adult Digenean Fluke

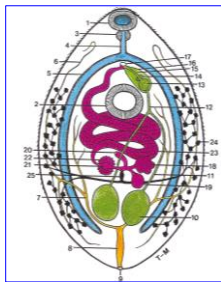
The basic body form of the adult trematode takes a number of different forms:



SCHISTOSOME

Elongate trematodes, with **separate sexes**, the male generally larger, holding the female within a **groove** formed by a folding of the male body (the **gynaecophoric canal**). Found within the circulatory system. (e.g. *Schistosoma mansoni*)

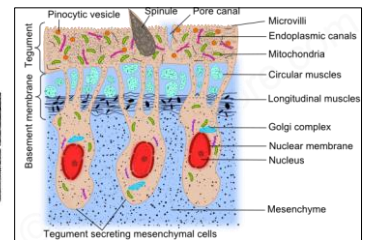
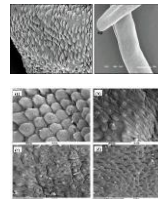
Morphology



Blue: digestive system
Yellow: excretory system
Green: male genital system
Red: female genital system
Black: vitelline glands

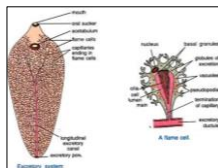
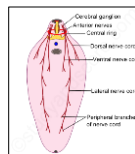
- oral sucker
- ventral sucker (acetabulum)
- pharynx
- esophagus
- intestine
- small excretory tubule
- collecting tube
- excretory bladder
- excretory pore
- testis
- vas deferens
- seminal vesicle
- prostate gland
- cirrus
- cirrus sac
- genital pore
- ovary
- seminal receptacle
- Lauren's canal
- ootype
- Mehlis' gland
- stercus
- vitelline gland
- common vitelline duct

DIGENEA – body surface



DIGENEA - systems

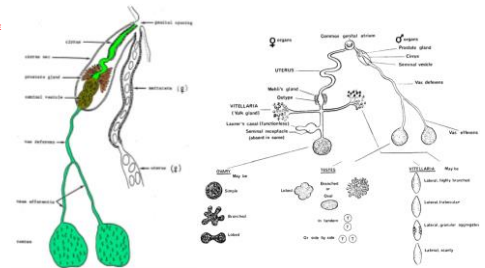
- Nervous system
- Excretory system
- The circulatory and respiratory systems



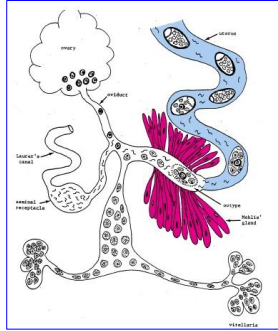
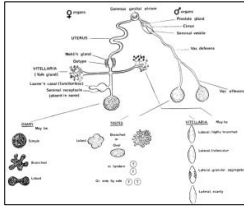
DIGENEA – reproductive system

➤ Hermaphrodites

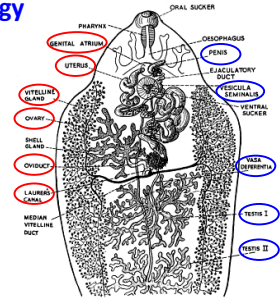
➤ MALE REPRODUCTIVE ORGANS:



Female reproductive organs:



Morphology

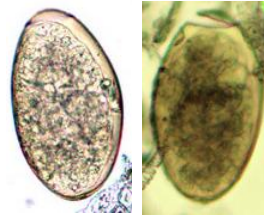


Digenea Life Cycle



- Complex life cycles with **at least two hosts** and several life cycle stages
- **First Intermediate host** is almost always a **snail**.
- Some have **another aquatic animal** as a **second intermediate host**.
- **Final host** is usually eats the second intermediate host with infection stages.
- **One exception** - *Schistosoma* spp.

Digenea Life Cycle – Egg - The flukes are **oviparous** and release (no embryonated) eggs into the external environment.



- Most digenea eggs have an **operculum**

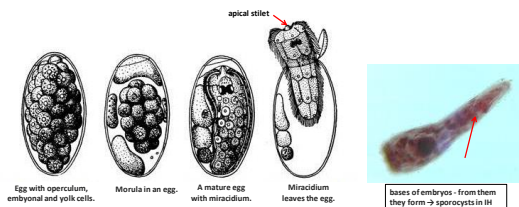


➤ Except *Schistosoma* thorn

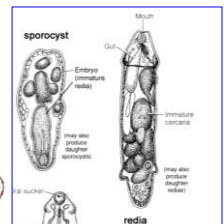
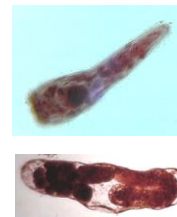
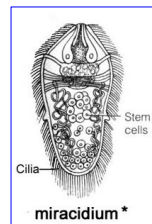
- Developing embryo (**miracidium**)
- Already fertilized and ready to hatch into new organism

DIGENEA – life cycle

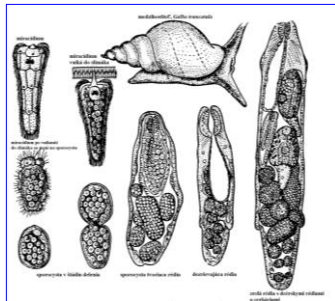
I. EMBRYOGONY



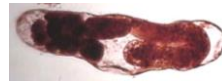
bases of embryos - from them they form → sporocysts in the



II. Parthenogony



Sporocyst

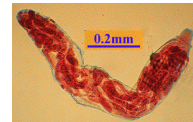


➤ When miracidium finds a snail, it penetrates its mantle and turns into a sporocyst

➤ "Sac" of embryos; it releases embryos into the snail

➤ Embryos can become **sporocyst**, **redia**, or **cercaria**

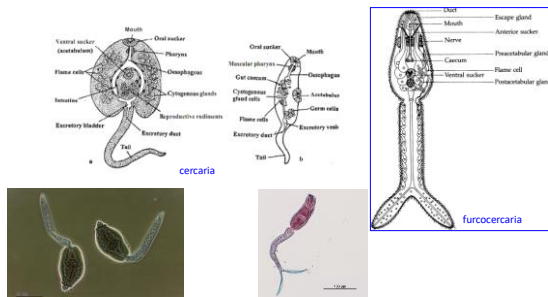
Redia



➤ Similar to a sporocyst but has a pharynx and small digestive system

➤ More mobile than sporocyst

➤ Makes **embryos** which can turn into **cercaria**



Cercaria



➤ Leaves the snail to find next host or to form **metacercaria**

➤ Looks like a miniature adult with a tail

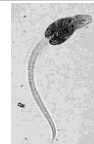
➤ Tail for swimming

➤ Loses tail

➤ Transform into **metacercaria**

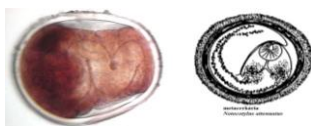
➤ Or it penetrates next host

➤ **Schistosoma cercaria** (**furcocercaria**) have forked-tails



III. CYSTOGONY

1. Cercariae penetrate directly;
2. Cercariae are encysted in the external environment;
3. Cercariae penetrate directly into the second intermediate host;
4. Cercariae are transformed into **mezocercaria** and **metacercaria** are created in the third intermediate host.



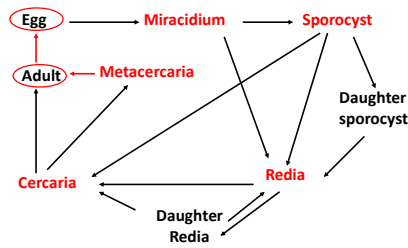
IV. MARITOGONY

Life cycle of digenea

➤ **Cercariae** are shed from the snail at rain events and encyst to become **metacercariae** on vegetation (**infective form for FH**);

➤ **FH** – infection by ingestion contaminated grass or hay; young flukes penetrate the small intestinal wall, migrate through peritoneal cavity, liver capsule to bile ducts; ...

Digene Life Cycle



Class: DIGenea

Order	Family	Genus
ECHINOSTOMIDA	Fasciolidae	<i>Fasciola</i> , <i>Fascioloides</i> , <i>Fasciolopsis</i> ,
	Echinostomatidae	<i>Echinostoma</i> , <i>Euparyphium</i> , <i>Echinoparyphium</i> , <i>Hypoderaeum</i> , <i>Philophthalmus</i> , ...
	Paramphistomidae	<i>Paramphistomum</i> , <i>Calicophoron</i> , <i>Cotylophoron</i> , <i>Gigantocotyle</i> , <i>Orthacoealum</i>
AMPHISTOMIDA	Gastrophysidae	<i>Gastrophysus</i> , <i>Gastrophysoides</i> , <i>Homalagaster</i>
	Gastrothylacidae	<i>Gastrothylax</i> , <i>Carmyerius</i> , <i>Fischederius</i>
	Dicrocoelidae	<i>Dicrocoelium</i> , <i>Eurytrema</i> , <i>Ptychosomum</i>
PLAGIORCHIDA	Prosthogonimidae	<i>Prosthogonimus</i>
	Troglostrematidae	<i>Collyricium</i> , <i>Troglostrema</i> , <i>Nanophyetus</i>
	Paragonimidae	<i>Paragonimus</i>
OPISTHORCHIDA	Heterophyidae	<i>Heterophyes</i> , <i>Metagonimus</i> , <i>Apophyllus</i>
	Opisthorchiidae	<i>Opisthorchis</i> (syn. <i>Clonorchis</i>), <i>Metorchis</i>
	Schistosomatidae	<i>Schistosoma</i> , <i>Bilharzia</i> , <i>Trichobilharzia</i> , <i>Orientobilharzia</i> , <i>Ornithobilharzia</i> , <i>Heterobilharzia</i> , <i>Australbilharzia</i>
STRIGEIDIDA	Strigidae	<i>Apotamus</i> , <i>Cotylurus</i> , <i>Parastrigea</i> , <i>Strigea</i>
	Diplostomidae	<i>Diplostomum</i> , <i>Alaria</i>

Order: ECHINOSTOMIDA

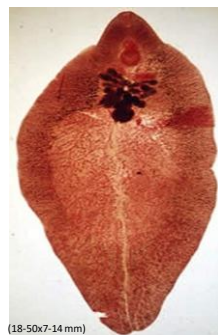
Family: **FASCIOLIDAE** – *Fasciola*, *Fascioloides*, *Fasciolopsis*, *Parafasciolopsis*
ECHINOSTOMATIDAE – *Echinoparyphium*, *Echinostoma*, *Hypoderaeum*, *Isthmiophora*

Family: **FASCIOLIDAE**

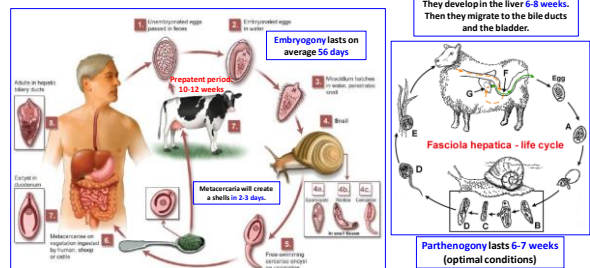
Fasciola, *Fascioloides*, *Fasciolopsis*, *Parafasciolopsis*

➤ Zoonotic

Species	IH	FH	Location
<i>Fasciola hepatica</i> (18-50x7-14 mm)	<i>Galba truncatula</i> (syn. <i>Lymnaea</i>) (Lymnaeidae)	Large Riv, Ox, Cap, Eq, Sus, buffalo, wild ruminants, man	bile ducts, bladder; juvenile: abdominal cavity, liver parenchyma;
<i>Fasciola gigantica</i> (24-75x5-12 mm)	<i>Radix</i> (Lymnaea)	Large Riv, buffalo, Ox, Cap, Eq, donkey, camel, man	Bile ducts
<i>Fascioloides magna</i> (70-100x20-30 mm)	<i>Galba truncatula</i> , <i>Lymnaea modicella</i> , ...	Wapiti, deer, fallow deer, Large Riv, Ox, Cap	Liver parenchyma
<i>Parafasciolopsis fasciolaemorphia</i> (9-7x3-2.5 mm)	<i>Planorbis</i> spp.	Moose, roe deer, fallow deer, bison, Ox	Small intestine, gall bladder, bile ducts
<i>Fasciolopsis buski</i> (30-75x8-20 mm)	<i>Segmentina</i> spp., <i>Hippuris</i> spp.	Sus, man	Small intestine

FASCIOLA HEPATICA/FASCIOSIS

Life cycle



Developmental stages of *Fasciola hepatica*



Fasciolosis: liver fluke disease

Distribution: worldwide, in grazing animals; **Endemic in temperate regions** around the world and US including the west coast, gulf coast, and rocky mountain region;

Veterinary significance: may be very high; The most important trematode in domestic ruminants;

Public health significance: low, **zoonosis** - about 2.4 million humans worldwide are infected; Human infections usually come from ingestion of metacercariae in water or on water cress;



Fasciolosis: liver fluke disease

Caused by:

➤ *Fasciola hepatica*, common liver fluke, prevalent in temperate areas, tropics, subtropics; 2-3 cm, bile ducts (gall bladder), occasionally other organs, such as lung, etc.

➤ *Fasciola gigantica*, large liver fluke, prevalent in tropical and subtropical region of Africa, Middle East, South-East Asia, China, India etc.

➤ **Host spectrum:** wide, most herbivorous mammals and humans

Life cycle: indirect

Intermediate hosts:

For *F. hepatica*: freshwater snails of the genus *Lymnaea*.
Lymnaea truncatula in Europe, highlands of Africa
Lymnaea tomentosa and *L. columella* in Australia, New Zealand

For *F. gigantica*: *L. auricularia*

Infection: per os

Prepatent period: 6 - 12 weeks

Epidemiology

➤ Endemic distribution

➤ Requirements: egg-laying hosts, wet environment, suitable snail species

➤ **Factor of stability:** longevity of infection, chronic egg production of adult fluke (20 000 eggs or more fluke/day)

➤ **Factors of instability:** availability of moisture, temperature (for development of fluke larvae and snails a mean temp. of at least 10 °C is needed).

➤ Metacercariae (MC) survive best on grass and hay at temperature below 20 °C, but die rapidly at higher temperature and desiccation.

➤ High intake of MC often occurs by forced grazing of wet areas during drought.



PATHOGENESIS AND CLINICAL MANIFESTATIONS



Transmission: Ingestion of metacercaria.
Location in Final host: Liver (juvenile form), bile ducts, bladder.

Adverse effects:

➤ Mechanical

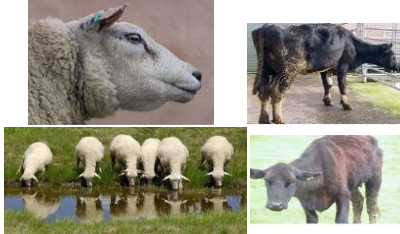
➤ Toxic

➤ Loss of blood

➤ These worms rely on a family of developmentally-regulated **papain-like cysteine peptidases**, termed **cathepsins**.
➤ These **proteolytic enzymes** play central roles in virulence, infection, tissue migration and modulation of host innate and adaptive immune responses.

ACUTE FORM OF FASCIOLOSIS

- sheep (on single ingestion > 2000 metacercariae per sheep)
- after 2-6 weeks - migration of juvenile fascioli in liver parenchyma = „*hepatitis traumatica*“, rupture of blood vessels, bleeding in abdominal cavity;

**SUBACUTE FORM OF FASCIOLOSIS**

- when ingesting 500-1500 metacercariae over a longer period;
- flukes in the bile ducts = inflammation (moderate *cholangitis*) + migration of juveniles in the parenchyma of the liver;

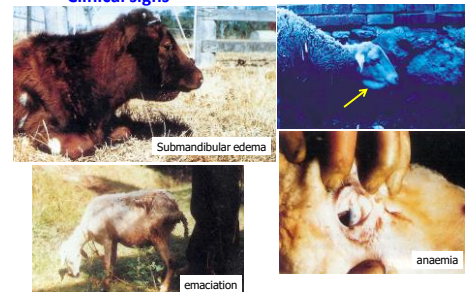
CHRONIC FORM OF FASCIOLOSIS

- end of winter, spring - 4-5 months after metacercariae (200-500);

**Immunity**

- **specific antibodies** are detectable in the serum from the third week p.i. by ELISA, IHA
- There is **no evidence of acquired resistance** in sheep and cattle, but infected cattle can spontaneously recover

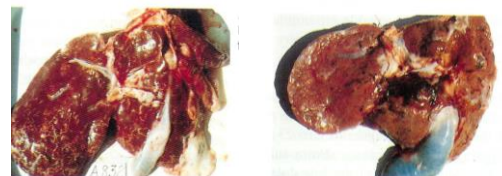
- **Sheep** - do not gain resistance to re-infection;
- **Cattle** - a certain degree of resistance to re-infection;

Clinical signs**Pathology**

Subacute form with hemorrhages and fibrosis



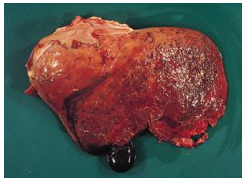
Subacute form

Pathology

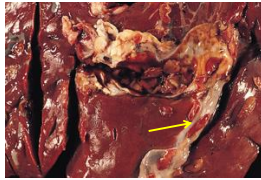
Migration of juvenile forms in sheep liver

Acute fasciolosis, massive hemorrhages

Pathology



Migration of young form in liver



Adult flukes in bile duct

Diagnosis

In vivo

- Clinical signs
- Coprologic methods (ovoscopy) – [sedimentation methods](#)
- Serologic – ELISA, IHA
- Acute form – elevation of GLDH-glutamyl dehydrogenase
- Chronic form – GGT gamma glutamyl transferase



Post – mortem

- Pathology, adult forms in liver and bile duct

Treatment

➤ **Acute disease:** stop grazing, keep affected flock indoors or move immediately to fluke – free pasture; treat with the flukicide which shows **90 – 100% efficacy** against immature and mature *F. hepatica* (**diamfenetid** (Coryphamin), **triclabendazol** (Fasinex), **rafoxanid** (Rafendazol); **Oxyclozanid**; **Closantel**;

➤ **Subacute and chronic disease:** use any flukicidal compound, preferably those effective against flukes aged 6 weeks or older (**nitroxylin**, **closantel**, **rafoxanid**, **triclabendazole**, e.t.c.);

Control

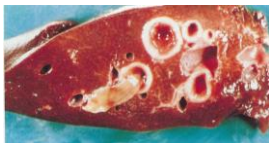
- Treatment of the infected hosts
- Reduction of snail habitats
- Other measures



Fasciola gigantica/tropical fasciolosis



Pathology

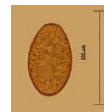
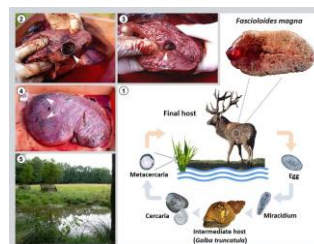


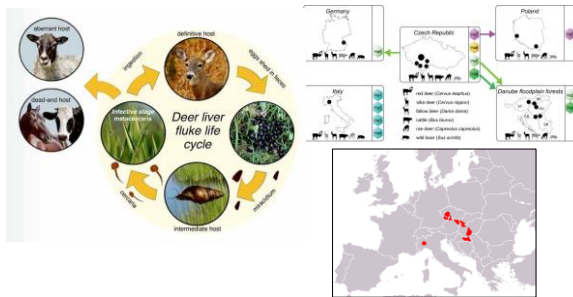
Liver fibrosis, cholangitis
F. gigantica



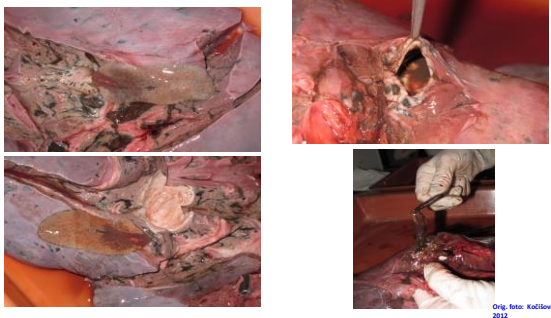
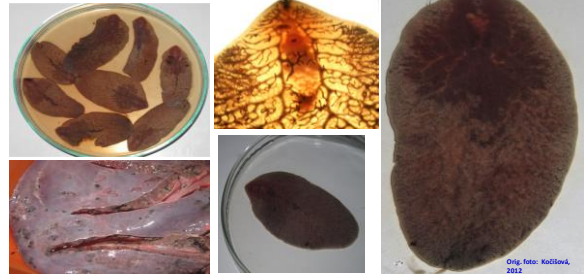
Chronic fasciolosis

Fascioloides magna





- *Fascioloides magna*
- liver parenchyma - typical pseudocysts



Pathology

- In deer and cattle

flukes tend to be **encapsulated in the liver** by host reaction and are less pathogenic

- In sheep and goats

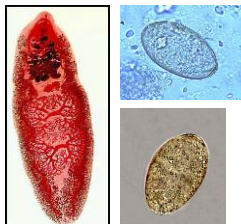
worms may migrate constantly in the liver tissue causing **traumatic hepatitis** which may be **fatal**;

vascular lesions are endophlebitis and thrombosis;
affected sheep usually die within 6 months

Fasciolopsis buski

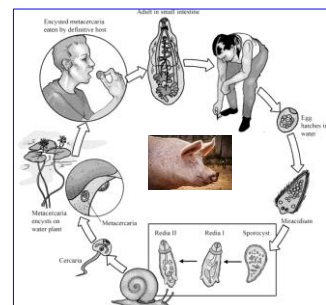


- **Geographic Distribution:** Orient.
 - About 210,000 people are infected.
- **Transmission to F.H.:** Ingestion of metacercaria on vegetation.
- **Location in F.H.:** Small Intestines



Fasciolopsis buski

- **Definitive Hosts:** Humans and Pigs
- **Intermediate Hosts:** Aquatic snails, particularly *Segmentina* and *Hippeutis*.
- **Source of infection:** Aquatic vegetation, including water chestnuts, water, lotus, and bamboo.



FASCIOLOPSIS BUSKI/Fasciolopiasis

Is prevalent in Southeast Asia and lives in humans and pigs' intestines, so it is also called **Asia Giant Intestinal Fluke**. The prevalence of fasciolopiasis is related to growing water plants and feeding pigs on water plants.

➤ HELMINTHOZOOONOSIS

➤ IH: fresh-water snail

➤ A men is infected with **metacercaria**;

➤ The flukes will **adhere to the duodenal and jejunal mucosa** of the intestine, they will grow to adult flukes in about **90 days**;

➤ **Death due to circulatory failure due to intoxication!**

Pathology - Generally very little. May obstruct small intestines and interfere with food absorption. Absorption of worm waste results in **verminous intoxication** similar to tapeworms.

➤ **Diagnosis:** finding of eggs in stool; ELISA;

➤ **Therapy:** praziquantel (Biltricide); bfenium (Alcopar); albendazole, mebendazole, levamisole, tiabendazole;

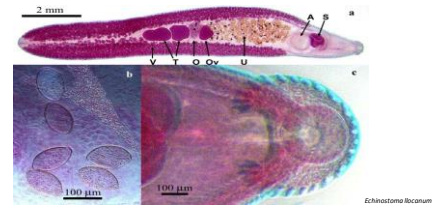
➤ **Prevention:** heat treatment of plants;

ECHINOSTOMATIDAE – Echinoparyphium, Echinostoma, Hypoderaeum, Isthmiophora

➤ Intestine of birds and mammals;

➤ Small suction sucker + head collar with thorns

➤ Life cycle: 1 IH (snail) or 2 IH (snails, aquatic animals)

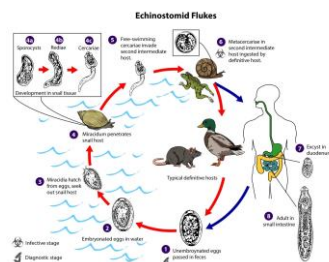


Echinostoma revolutum



Echinostoma revolutum

Species	IH	HH	Location
<i>Echinostoma revolutum</i> 6.5-30x0.6-1.6mm	I. Water snail Lymnaeidae; II. Water snail Planorbidae	duck, goose, pigeon, chicken, turkey	ileum, cecum, rectum
<i>Echinoparyphium recurvatum</i> 1.5-4.5x0.7 mm	I. snail Lymnaeidae; II. snail, frog	duck, geese, waterfowl, rarely chickens, pigeon	small intestine
<i>Hypoderaeum conoideum</i> 12x2 mm	I. snail Lymnaeidae; II. Snail, frog, leech	duck, goose, waterfowl, chicken, pigeon	small intestine
<i>Isthmiophora melis</i> 2.4-11x0.7-1.6mm	I. snail Lymnaeidae; II. frog, fish	weasel, fox, hedgehog, cat, pig, ...	small intestine

**Phthilophthalmidae:**

➤ eye of birds

➤ development over 1 IH

➤ *Phthilophthalmus posaviniensis*

➤ *Ph. gralli*

➤ *Ph. anatinus*

➤ *Ph. lacrymosus*

➤ attached to the **third eyelash** - thickening, hyperemia, erosion, corneal opacity, blindness;

➤ increased tear;

➤ dried secretions in the corner of the eye;

➤ niklozamid, rafoxamid, oxyclozanid, praziquantel

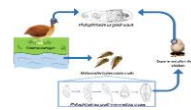


Fig. 2. *Phthilophthalmus lacrymosus*. T: oral sucker, MC: muscular cornea, VS: ventral sucker, DVCD: dorsal vitelline follicles, leg. duct: LG: vagina, O: ovary, AT: anterior testis, PT: posterior testis. Bar = 0.2 mm.



Philopthalmus gralli



Philopthalmus lachrymosus