TREMATEODES

I. Platyhelminthes
   A. Characteristics
      Triploblastic, Bilateral, Acoelomate (⇒ Parenchyma), Dorso-ventrally Flattened, Longitudinal &
      Circular Muscle Layers, Syncytial Tegument, Incomplete Digestive System (Absent in Cestodes),
      Hermaphroditic = Monoecious (Except Blood Flukes are Dioecious).
   B. Groups of Veterinary Importance
      Class Trematoda = Flukes
         Order Monogenea = Monogenetic Trematodes
            Ecto-Parasites of Fish
               (ex. Gyrodactylus sp., Polystomum sp., Benedinia sp.)
         Order Digenea = Digenetic Trematodes
            Endo-Parasites of Vertebrates
               (ex. Fasciola sp., Paragonimus sp., etc.)
      Class Cestoda = Tapeworms
         Endo-Parasites of Vertebrates
            (ex. Taenia sp., Anoplocephala sp., etc.)

II. Digenetic Trematodes
   A. General
      1. Flatworms
      2. Complex Life Cycles
         a. digenea (di = two), (genea = beginnings)
         b. Sexual Reproduction ⇒ Adult worms in definitive host
         c. Asexual Reproduction ⇒ Larval worms in snail host
   B. Morphologic Characteristics
      1. General Flatworm Characteristics
      2. Suckers and/or holdfast organs
      3. Incomplete gut
      4. Reproductive organs (testes, ovary, vitellaria)

   C. Complex Life Cycle
      1. Definitive Host
         a. Adult Worms
            (Sexual Reproduction)
      2. Environment
         a. Ovum (Distribution)
         b. Miracidium (Distribution)
      3. Molluscan 1st Intermediate Host
         a. Sporocysts and/or Redia
            (Asexual Reproduction)
      4. Environment
         a. Cercaria (Distribution)
      5. 2nd Intermediate Host or Environment
         a. Metacercaria (Transmission)
      6. Marita or Young flukes (Development)
D. Digenean Groups
   1. In general, grouped by location in definitive host.

<table>
<thead>
<tr>
<th>Large Animals</th>
<th>Small Animals</th>
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<tbody>
<tr>
<td>Liver Flukes &amp; Bile Duct Flukes</td>
<td>Bile Duct &amp; Pancreatic Duct Flukes</td>
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<tr>
<td><em>Fasciola</em> (ruminants)</td>
<td><em>Platynosomum</em> (cats)</td>
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<tr>
<td><em>Fascioloides</em> (ruminants)</td>
<td><em>Eurytrema</em> (cats)</td>
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<tr>
<td><em>Dicrocoelium</em> (ruminants)</td>
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<tr>
<td>Intestinal Flukes</td>
<td>Lung Flukes</td>
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<tr>
<td><em>Acanthatrium</em> (bat / horse)</td>
<td><em>Paragonimus</em> (dogs, cats)</td>
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<td>Intestinal Flukes</td>
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<td><em>Nanophyetus</em> (dogs, cats)</td>
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<td>Blood Flukes</td>
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<td><em>Heterobilharzia</em> (dogs)</td>
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Fasciola hepatica
Common Liver Fluke

A. Morphology
- Large, leaf-like, liver/bile duct flukes
- Suckers: small, anterior
- Dendritic Intestines, Testes & Ovary

B. Life Cycle
1. Definitive Hosts
   - Cattle, Sheep, Goats, Camels
2. Ova, Miracidia
3. Molluscan 1st Intermediate Host
   - Aquatic snails (pond / puddle snails)
   - Sporocysts and Redia
4. Cercaria
5. Environment
   - Metacercariae on Aquatic Vegetation
   - Ingested by definitive host
6. Young Flukes
   - Young flukes migrate through liver parenchyma
   - Adult Flukes in bile ducts
7. Prepatent period: about 2 months
8. Entire Life Cycle: 3-6 months

C. Geographic Distribution
1. Florida & Puerto Rico
2. Gulf Coast States
3. Pacific Northwest
4. Not endemic in North Carolina

D. Pathology
1. Acute
   - Due to migration of young flukes through liver
   - Severe liver damage, hemorrhage, inflammation
   - May result in sudden death, especially in goats & sheep
   - Potential for hepatic clostridial infections & death
   - Black Dz (*Clostridium novyi*) & Red Water Dz (*Clostridium hemolyticum*)
2. Chronic
   - Due to adults in bile ducts
   - Loss of condition, weakness, anemia, hypoproteinemia
   - Liver & bile duct fibrosis, cholangiohepatitis
   - Stenosis of bile ducts w/ eventual calcification.
   - Usually results in liver condemnation

E. Diagnosis
- Fecal Sedimentation (chronic DZ only)
- Clinical Signs: Loss of condition, weakness, anemia, edema & "bottle-jaw"
- Liver Enzyme Analysis
- Necropsy
- Herd History

F. Treatment
1. Clorsulon (*Curatrem & Ivomec Plus*)
   - Not licensed for breeding dairy cattle
   - 8 day pre-slaughter withdrawal time
2. Albendazole (*Valbazen Suspension PI*)
   - Not licensed for breeding dairy cattle
   - 27 day pre-slaughter withdrawal time
3. Strategic Drug Control
   - Ivermectin + Clorsulon (*Ivomec Plus*)
   - Early fall in Southern US

G. Control
1. Snail Control
   - Mollusccides
   - Adequate pasture drainage
2. Grazing Control
   - Restrict access to wet areas

H. Zoonosis
1. Human Fascioliasis – ingest metacercaria w/ raw vegetation. (Europe, Africa, Cuba, South America)
2. Halozoun - Ingestion of raw liver. Adult worms attach to nasopharynx
**Fascioloides magna**

**Giant American Liver Fluke**

**A. Morphology**
- Very Large, leaf-like, liver flukes
- Suckers: small, anterior
- Dendritic Intestines, Testes & Ovary

**B. Life Cycle**
1. Cervids (deer, elk)
2. Aquatic snails (pond / puddle / swamp)
3. Aquatic Vegetation
4. Young Flukes
   - Young flukes migrate through liver parenchyma
   - Adults mature in liver cysts with connections to bile ducts
5. Dead-end Hosts
   - Sheep & Goats: migration of young flukes cause liver damage & death
   - Cattle: Adult worms walled off in fibrotic cysts

**C. Geographic Distribution**
1. Scattered throughout US
2. Prevents goat & sheep production in Minnesota & Michigan
3. Sporadic in white-tailed deer throughout North Carolina
   - Emerging problem for goats, sheep, llama, and cattle in NC

**D. Pathology**
1. Wild Cervids
   - Usually minor liver damage
2. Sheep & Goats
   - Severe liver damage, hemorrhage, inflammation
   - Usually results in sudden death
3. Cattle
   - Minor damage, unless very heavy infection
   - Liver Condemnations

**E. Diagnosis**
1. Wild Cervids
   - Fecal Sedimentation
   - Necropsy
2. Domestic Ruminants (non-patent)
   - Necropsy
   - Swampy pastures shared with wild cervids.

**F. Treatment**
1. Wild Cervids
   - Clorsulon
   - Albendazole
2. Domestic Ruminants
   - No good treatment

**G. Control**
1. Snail Control
   - adequate pasture drainage
2. Grazing Control
   - Restrict access to wet areas
   - Restrict wild cervid access to pastures w/ water feature (pond, ditch, etc.)

**H. Zoonosis:** NONE

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**Dicrocoelium dendriticum**  
**Lancet Fluke**

A. Morphology
- Translucent, lancet-shaped bile duct flukes.
- Ventral sucker in anterior half of body.
- Globular tandem testes; posterior to the ventral sucker. Globular ovary posterior to testes.

B. Life Cycle:
1. **Definitive Hosts & Distribution**
   - Ruminants (Sheep & Goats); Variety of others (Cattle, deer, rabbits, pig, etc.)
   - Bile ducts
   - Prepatent Period: 80 days
   - Terrestrial snail & ants
   - Northeast US & Canada, and widely distributed around the world

C. Pathology
- Non-pathogenic in younger animals
- Bile duct hyperplasia, hepatic cirrhosis
- Slow chronic progressive disease causing decreased productivity in older animals

D. Diagnosis
- Edema & emaciation in older stock
- Ova in sedimentation

E. Treatment ---- Albendazole in high doses
F. Control ---- Eradicate Ant hills
G. Zoonosis --- Very Rare

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