

DISEASES OF FISH



Viral Diseases

● Lymphocystis Disease

A) Iridovirus

B) Observed in most freshwater and saltwater species

C) Clinically fish are presented with variably sized white to yellow cauliflower growths on the skin fins and occasional gills. Occasionally this virus may go systemic with white nodules on the mesentery and peritoneum.

D) Histopathology: Fibroblast undergoes cytomegaly with many basophilic cytoplasmic inclusion bodies and a thick outer hyalin capsule. The inflammatory response is variable but is usually a chronic lymphocytic inflammatory infiltrate.

E) The disease gains entry through epidermal abrasions. The virus infects dermal fibroblasts.

F) The disease is self-limiting and refractory to treatment. Nodules may last several months and cause infected fish to be susceptible to secondary bacterial infections. Reinfection can occur.

● Herpesvirus salmonis (Herpesvirus disease of Salmonids)

A) Herpesvirus

B) Disease is observed primarily in fry of Rainbow trout.

C) Clinically the fish are lethargic with prominent gill pallor. Mucoïd fecal casts are commonly observed trailing from vent.

D) Lesions: 1) Exophthalmus and ascites

- 2) **Low hematocrit and numerous immature erythrocytes**
- 3) **Hemorrhage in eyes and base of fins**

E) Histopathology:

- 1) **Multifocal areas of necrosis of the myocardium, liver, kidney, and posterior gut (leading to cast formation**
- 2) **Syncytial cells involving the acinar cells of the pancreas is considered to be a pathognomonic sign.**

F) Transmission of the virus is believed to be direct.

G) Control is by avoiding exposing susceptible trout to the virus. If the disease occurs, raising the water temperature to 15°C or more will minimize losses.

● Channel Catfish Virus

A) Herpesvirus

B) Observed in fry or fingerling channel catfish (less than 10 gram weight) during the summer when water temperatures are above 22°C.

C) Clinically these fish usually show erratic swimming or spiralling followed by terminal lethargy. Mortality is very high.

D) Lesions:

- 1) **Hemorrhage at the base of the fins and skins;**
- 2) **Ascites; exophthalmos; and pale gills;**
- 3) **Kidneys swollen and pale with hemorrhage;**
- 4) **Spleen is enlarged and dark red;**
- 5) **Gills usually pale;**

E) Histopathology: Multifocal areas of necrosis and hemorrhage are observed in the posterior kidney, liver, intestines, and spleen.

F) Infection is direct with transmission of the virus in the water or feed. Piscivorous birds, snakes, or turtles may mechanically carry the virus from pond to pond. Transovarian transmission has not been conclusively demonstrated but is suspected. Survivors are persistently infected and become carriers for life.

G) Control of the disease is by sanitation, purchasing of virus free broodstock and

lowering water temperature to less than 19°C during an outbreak to lessen the mortality.

● **Epithelioma papillosum (Fish Pox)**

A) **Herpesvirus cyprini**

B) **Non-fatal disease is observed in carp and other cyprinids**

C) **Lesions: Elevation of the epidermis with the formation of white to yellow plaques over the body of the fish. Healed lesions usually turn black.**

D) **Histopathology: There is epidermal hyperplasia with the epithelial cells occasionally demonstrating intranuclear inclusion bodies.**

E) **Transmission is unknown, however, it is probably direct.**

● **Infectious Hematopoietic Necrosis (IHN)**

A) **Rhabdovirus**

B) **The disease is observed in fry of trout (rainbow) and salmon (chinook and sockeye) with mortality up to 100%.**

C) **Clinical signs and lesions:**

- 1) **Fish become lethargic or hyperactive.**
- 2) **The fish become dark in color.**
- 3) **Exophthalmus, abdominal distension, and fecal cast.**
- 4) **Hemorrhage on skin and viscera primarily at base of fins behind the skull and above the lateral line.**
- 5) **Anemia with pale gills.**

D) **Histopathology: There is prominent necrosis of hematopoietic tissue including melanomacrophages of the kidney, red pulp of the spleen and hepatic parenchyma. Necrosis of the submucosal eosinophilic granular cells is considered pathognomonic for IHN. (This lesion is observed in other systemic viral diseases.) Intranuclear and intracytoplasmic inclusions are occasionally observed in acinar and islet cells of pancreas.**

E) **The virus is transmitted by direct contact with infected survivors or by feeding contaminated feed. The virus is probably shed in contaminated semen and eggs. The disease is most severe at 10°C.**

● **Spring Viremia of Carp (SVC) and Swim Bladder Infection virus (SBI)**

A) **Caused by several subtypes of Rhabdovirus carpio.**

B) **Disease occurs in carp and other cyprinids.**

C) **Clinical Signs and Lesions:**

- 1) **Loss of coordination and equilibrium.**
- 2) **Exophthalmus and abdominal distension (ascites).**
- 3) **Inflamed and swollen vent.**
- 4) **Edema and hemorrhage in many organs.**
- 5) **In SBI see pronounced inflammation and hemorrhage of**

Swim-bladder.

D) **Transmission: Virus shed in feces and found in contaminated eggs.**

● **Infectious Pancreatic Necrosis (IPN)**

A) **Birnavirus**

B) **Affects most salmonids primarily rainbow trout and brook trout. IPN has also been implicated in disease among several nonsalmonid fish.**

C) **Clinical signs and lesions:**

- 1) **IPN is characterized by a sudden explosive outbreak with high mortality**
- 2) **Affected fish become dark and rotate their bodies while swimming.**
- 3) **Diseased fish usually have distended abdomens and exophthalmus.**
- 4) **The presence of a gelatinous material in the stomach and anterior intestine is highly suggestive of IPN; mucoid fecal casts are common.**

5) **Infected fish commonly have low hematocrits and hemorrhage in gut, primarily in the area of the pyloric ceca.**

D) **Histopathology:**

Histologically, there is necrosis of the pancreatic acini, gut mucosa, and renal hematopoietic elements. A moderate inflammatory infiltrate is usually observed around the pancreatic acini. Hyalin degeneration of skeletal muscle is also observed.

Bacterial Diseases

● Aeromonas hydrophila (Bacterial Hemorrhagic Septicemia)

A) **Gram negative motile rods**

B) **Effects many freshwater species and usually is associated with stress and overcrowding.**

C) **The clinical signs and lesions are variable.**

The most common finding is hemorrhage in skin, fins, oral cavity and muscles with superficial ulceration of the epidermis. Occasionally cavitory ulcers (similar to *A. salmonicida*) are observed. Exophthalmus is occasionally observed.

D) **Diagnosis is rendered by culturing the organism from affected animals: Remember this is a common water saprophyte with a great variation in virulence in serotypes.**

E) **Disease is transmitted via contaminated water or diseased fish.**

● Pseudomonas fluorescens

A) **Gram negative rod**

B) **Lesions similar to *Aeromonas hydrophila***

● **Vibrio**

- A) **Gram negative rod, lives primarily in a marine environment**
- B) **Vibrio septicemia: *V. alginolyticus* / *V. anguillarum* Septicemia has similar lesions to *Aeromonas hydrophila*.**
- C) **Ulcer Disease of Damselfish: *V. damsela***
 - a. **Deep skin ulcers and necrotizing myositis.**
 - b. **Lesions similar to *Aeromonas salmonicida*.**

● **Edwardsiella tarda (Edwardsiella septicemia)**

- A) **Gram negative motile rod**
- B) **The disease affects primarily channel catfish but also observed in goldfish, golden shiners, largemouth bass, and the brown bullhead. This organism is the most serious disease involving the eel culture of Asia.**
- C) **The lesions are similar to *A. hydrophila* with small cutaneous ulcers and hemorrhage observed both in the skin and muscle. Muscle lesions often develop into large gas filled (malodorous) cavities. Diseased fish lose control over the posterior half of their body yet continue to feed.**

● **Edwardsiella ictaluri (Enteric septicemia of catfish)**

- A) **Gram negative rod**
- B) **Disease affects primarily fingerlings and yearling catfish**
- C) **Clinical signs of enteric septicemia of catfish closely resembles those of other systemic bacterial infections. The most characteristic external lesion is the presence of a raised or open ulcer on the frontal bone of the skull between the eyes (Hole in the head disease).**

● **Aeromonas salmonicida (Furunculosis, Ulcerative disease of goldfish)**

- A) **Gram negative rod**

B) This bacteria affects primarily salmonids but other freshwater fish can be affected.

C) Clinically the disease may be demonstrated as a septicemia with hemorrhage in the muscles and other sites. The major lesion is a subcutaneous swelling that often causes an ulcerative dermatitis. These lesions may cavitate into the adjacent musculature. Histologically there is necrosis of the affected tissue with abundant colonies of bacteria and few inflammatory cells due to the bacteria's leukocytolytic exotoxin.

D) The disease is transmitted by contact with diseased fish, contaminated water, fomites, and infected eggs.

● *Yersinia ruckeri* (Enteric red-mouth)

A) Gram-negative motile rod

B) The bacteria affects salmonids; rainbow trout are the most susceptible.

C) Clinically this disease manifest itself as a septicemia with hemorrhage and ulceration of the jaw, palate, and operculum. Histologically numerous bacterial colonies admixed with inflammatory cells are observed in many areas of necrosis involving the liver, spleen and kidney.

D) The disease is transmitted by contact with diseased or carrier fish, and contaminated water.

● *Flexibacter columnaris* (Columnaris disease or Saddlepatch disease)

A) Gram-negative slender rods

B) The disease is a serous disease of young salmonids, catfish and many other fish.

C) This is a highly communicable disease. Lesions usually first appear on the caudal fin and progresses towards the head. The caudal fin and anal fins are severely eroded. As the disease progresses the skin is often involved with numerous gray-white ulcers. Gills are a common site of damage and may be the only affected area. The gill lesions are characterized by necrosis of the distal end of the gill filament which progresses basally to involve the entire filament.

D) *Flexibacter columnaris* infections are frequently associated with stress conditions. Predisposing factors for columnaris disease are high water temperature (25oC-32oC.), crowding, injury, and poor water quality (low oxygen).

● Bacterial Gill Disease

A) Bacterial gill disease is caused by a variety of bacteria. *Flexibacter columnaris*, *Cytophagia psychrophilia* and various species of *Flavobacterium* (all are gram negative rods) are the primary bacteria involved in this disease.

B) Fry are the most susceptible to the disease, however all ages may be affected. Clinically the fish become anorectic, and face the water current. Prominent hyperplasia of the gills is evident on gross and microscopic examination. Microscopically one observes proliferation of the epithelium which result in clubbing and fusion of the lamella.

C) Overcrowding, accumulation of metabolite waste products (particularly ammonia), organic matter in the water, and an increase in water temperature may all be predisposing factors.

● *Renibacterium salmoninarum* (Bacterial Kidney Disease)

A) Gram positive nonmotile diplobacillus.

B) This is a disease of salmonids. Brook trout are the most severely affected species.

C) The disease follows a slow course with clinical signs not present until the fish is well grown. The fish may exhibit exophthalmus, skin darkening, and hemorrhage at the base of the fins. Cutaneous vesicles and ulcers may develop. Numerous granulomas are observed in the kidney and may be also present in the spleen, heart and liver. Contraction of muscles is occasionally observed.

D) Transmission of the disease is believed to be via direct contact with contaminated fish. It is believed that the organism enters through the epidermis and then becomes a systemic disease.

● *Mycobacterium* species (Tuberculosis)

- A) Gram positive, acid fast rods (*M. marinum*, *M. chelonae* and *M. fortuitum* are the most common *Mycobacterium* species involved.)**
- B) All species of fish are affected. This disease affects both saltwater and freshwater aquariums.**
- C) Clinical signs of tuberculosis are quite variable. The most common signs are anorexia, emaciation, vertebral deformities, exophthalmus, and loss of normal coloration. Numerous granulomas are often observed in various organs throughout the body. Often numerous acid-fast bacteria are observed in the granulomas.**
- D) Once an aquarium is infected with this disease it is difficult to remove except by depopulation of the aquarium and disinfecting the tank. Remember this is a zoonotic disease (atypical mycobacteriosis).**

● ***Nocardia* sp.**

- A) Gram-positive filamentous rod (weakly acid-fast positive)**
- B) The organism is a problem with mostly aquarium fish. However, it has become observed in cultured salmonids.**
- C) Clinically this is a chronic disease characterized by raised masses in the mouth, gills and skin. Dermal masses eventually ulcerate. Numerous white raised nodules (granulomas) are often observed in the viscera.**
- D) The exact route of transmission is unknown. However it is felt that entry through wounds and abrasions is the most common source of infection. (Ingestion of the bacteria has been known to cause the disease.)**

● ***Flavobacterium* sp.**

- A) Gram-negative rods**
- B) Usually a problem for individual fish. This disease is a cause of concern to primarily hobbyist and producers of ornamental fish.**
- C) Infected fish are usually emaciated and pale. Multifocal white nodules are observed in the visceral organs and the brain. These nodules may be cystic or**

mineralized. Histologically the nodules are granulomas with a caseous center, a thin peripheral rim of macrophages and lymphocytes and a fibrous capsule.(Must be differentiated from Mycobacterium)

D) The mode of transmission is unknown.

● Epitheliocystis (Chlamydial infection)

A) Obligated intercellular parasite. Organism stain red with Machiavello stain.

B) These organisms have been observed in many species of fish.

C) Clinically infected fish may be asymptomatic or show respiratory distress. Multiple white cysts are observed on the gill lamella and skin. Histologically the cyst consists of distended epithelial cells with numerous basophilic organism.

D) The means of transmission is unknown.

Mycotic Diseases

● Saprolegniasis

A) Caused by various groups of aquatic fungi; primarily Saprolegnia, Achlya, and Aphanomyces.

B) Saprolegniasis affects all species and ages of freshwater and estuarine fish.

C) Clinically, affected fish develop white to brown cotton-like growths on skin, fins, and gills. This organism is an opportunist which will usually grow over previous ulcers or lesions. Diagnosis is by finding nonseptated branching hyphae that produce motile flagellated zoospores in the terminal sporangia.

D) Most fish die due to osmotic or respiratory problems if the area of skin or gills is large.

E) The fungi are normal water inhabitants that invade the traumatized epidermis. Improper handling, bacterial or viral skin diseases, and trauma are the major causes

of the disease. It is interesting to note that temperature has a significant effect on the development of infections. Most epizootics occur when temperatures are below the optimal temperature range for that species of fish.

● **Branchiomycosis (Gill rot)**

A) Caused by two species *Branchiomyces sanguinis* and *B. demigrans*.

B) Primarily a problem in carp and eels.

C) Affected fish usually show respiratory distress. There is prominent gill necrosis caused by thrombosis of blood vessels in the gills. Histologically the identification of nonseptated branching hyphae with an intrahyphal eosinophilic round body (apleospores) in and around blood vessels of the gill is diagnostic.

D) The disease occurs most commonly in ponds with abundant organic matter, and high ammonia levels. Usually warm water temperatures (20-25°C) bring about the disease.

● **Ichthyosporidiosis**

A) *Ichthyophonus hoferi*; large 10-250 micron spores which may germinate to form large hyphae.

B) This fungus infects all species of fish.

C) Clinically the fish are emaciated with small round occasionally ulcerated black granulomas in the skin. Scoliosis is occasionally observed. Internally numerous granulomas are observed in many visceral organs. Microscopically the lesion consists of granulomas with encysted large PAS-positive spores. Occasionally large irregular shaped hyphae are observed.

D) Transmission is unknown.

● **Exophiala sp.**

A) *Exophiala salmonis* and *E. pisciphila*; these fungal organisms have hyphae that are septated, irregular in width and branched.

B) This disease is observed in many species of fresh and saltwater fish. *E. salmonis* has become an organism of increased importance in caged cultured salmonids.

C) Clinically the fish become darker, and lethargic. Occasionally dermal nodules are present. Numerous round yellow to white granulomas are present in visceral organs (liver, kidney, spleen). Histologically, branched, irregular width, septated hyphae are present in the lesions.

D) Transmission is unknown.

External Protozoal Diseases

● Ichthyophthirius multifiliis ("Ich" or White Spot Disease)

A) The largest protozoan parasite of fish. The trophozoite are up to 100 microns diameter, ciliated and contain an oval horseshoe shaped nucleus.

B) This is a disease of aquarium and hatchery reared fish.

C) Clinically fish become hyperactive with fish flashing and cutting against rocks or sides of aquariums. As the trophozoites enlarge they cause hyperplasia of the epidermis with white spots forming on the skin and gills. Severely infected fish may have respiratory problems and die. Histologically there is epidermal hyperplasia with the encysted trophozoite present in the epidermis.

D) The life cycle is direct. Encysted trophozoites (trophont) leave the fish and settle to the bottom of the tank. The trophozoites (tomonts) divide into numerous tomites (theronts) which are released to infect the skin of the fish. The life cycle takes approximately 4 days to complete. However, it can be sped up by increasing the water temperature.

E) The only way to treat the disease is by interrupting the life cycle of the parasite. Removal of fish from the infected water for 3 days (25°C) will usually interrupt the life cycle (Tomites live only 48 hours at 26°C). One must treat the water to kill the tomites to prevent spread of the disease (Malachite green, formalin, methylene blue, or KMnO₄). Remember, these treatments only kill the tomites and not the trophozoites that are encysted in the fish.

F) *Cryptocaryon irritans* is the salt water equivalent to *Ichthyophthirius*.

● ***Ichthyobodo necatrix* (Costiasis)**

A) Piriform shaped protozoa 6-12 microns long with two short and two long flagella. These are stalked protozoa which attach to the skin or gills.

B) This disease is observed in most aquariums and hatchery raised fish. This disease occurs primarily in cold waters (10°C) and affects very young fish when they are just beginning to eat food.

C) Clinically the fish may flash, produce abundant mucus over the skin (blue slime disease) and/or show respiratory distress (flaring of gills). Histologically the parasites are attached to the epithelial surface of the skin or gills.

D) Transmission of the parasite is by direct contact with the protozoa. This protozoa is a free swimmer so it can swim and then attach to the host where it undergoes binary fusion for reproduction.

● ***Trichodina* sp. (Trichodiniasis)**

A) This disease is caused by a group of peritrichal ciliated protozoans. The organisms are saucer-shaped, 50 microns diameter, with rows of cilia at either end and a macro and micro nucleus. When viewed dorsoventrally the parasite appears as an ornate disk with a characteristic ring of interlocking denticles forming a circle in the middle of the organism.

B) These are observed on most fresh and saltwater fish. This protozoa is relatively common on many fish and is not always associated with disease.

C) Clinically fish usually exhibit flashing and become lethargic. There is an increase in mucus production causing a white to bluish haze on the skin. The skin may develop ulcers and the fins may fray. If the gills are involved the fish may have severe respiratory distress. Histologically masses of organisms are attached by adhesive discs and denticles of exoskeleton to the epidermis. The underlying epithelial cells undergo necrosis. There is secondary hyperplasia and hypertrophy of the gill epithelium.

D) Transmission is by direct contact with infected fish and or contaminated water.

● Tetrahymena corlissi

A) Normally a free-living oval ciliated 50-70 micron long protozoa.

B) The organism has been known to affect the fry of various cultured fish (Guppy and Northern pike).

C) Clinically, one may observe necrosis and hemorrhage of the skin. In severe cases the fish have rupture of the body walls and the fish eviscerate. Histologically one observes massive invasion of the musculature by this organism. (The ventral abdominal wall is severely affected.)

D) This is a free-living protozoan that only becomes a problem at times of overcrowding and poor water quality.(water having a high organic matter content)

● Dinoflagellates (Velvet disease, Coral fish disease)

A) Dinoflagellate 100 microns diameter containing chromatophores and a single eccentric nucleus. When free swimming they are 20 microns diameter contain a transverse flagellum in the transverse furrow and a longitudinal flagellum in the longitudinal sulcus. Several species of dinoflagellate are involved:

- 1) Oodinium - Velvet disease**
- 2) Amyloodinium - Coral fish disease**

B) Problem in aquarium and cultured fish.

C) Clinically, fish flash in the water and become depressed with lateral opercular movement. A shimmering heavy yellow colored mucus secretion over the skin and gills is observed. Histologically large oval organism (80 microns diameter) with multiple chromatophores and a single eccentric nucleus are attached to epithelial cells by a pseudopodia.

D) Transmission is by direct contact with infected fish, and contaminated water.

● Epistylis (Red sore disease)

- A. Branched stalked ciliated protozoan (Heteropolaria sp.).**
- B. Found primarily in wild populations of scaled fish.**
- C. Clinically one observes ulcers or cotton-like growth on the skin, scales and spine resulting in a red-colored lesion. In catfish the lesion involves the spines and bones which underlie the skin of the head and pectoral girdle. This protozoan parasite has also been observed on eggs.**
- D. This ciliated protozoan is primarily a free living protozoan that lives on aquatic plants and is believed to be an opportunist. Outbreaks have occurred in catfish and salmon that have been maintained in water high in organic content.**

● **Glossatella**

- A) This disease is caused by the ciliated protozoan Apiosoma which has a barrel-shaped body with cilia at the distal end and a large rounded macronucleus.**
- B) This organism usually is not a problem but can affect many species of fish.**
- C) The organism can appear on the gills or skin causing increased mucus production and hyperplasia. Severe infections of the gills will cause respiratory problems.**
- D) This disease is a problem when fish are exposed to poor water quality.**

Internal Protozoal Diseases

● **Henneguya (Proliferative gill disease, Hamburger gill disease)**

- A) Myxosporidean parasite with two polar capsules and a long tail like extension of the spore shell.**
- B) Problem in many cultured freshwater fish involves primarily new ponds.**
- C) Clinically fish are presented with numerous white cysts on the skin and gills.**

Cysts observed on the gills (both intralamellar and interlamellar) can cause extensive granulomatous inflammation and hyperplasia of the gill surface leading to serious respiratory problems. Cysts have been detected in other organs (brain, spleen, liver, and kidney).

D) The life cycle is unknown. Some feel it is a direct life cycle, others feel that an intermediate host (a mud worm) is involved.

E) Currently there is confusion as to what is the true cause of proliferative gill disease. *Henneguya exilis* kudo was once believed the myxosporidean agent responsible. Recent evidence suggests that the interlamellar form which evokes the inflammatory response may be due to other sporozoan parasites. One group suggests (MacMillin 1989 and Hedrick, 1990) that this may represent the extrasporogenic stage of the myxozoan *Sphaerospora ictaluri*. Another group (Burtle) suggests that this lesion is due to the triactinomyxid myxozoan of an unidentified species of *Aurantiactinomyxo*.

● *Myxobolus cerebralis* (*Myxosoma cerebralis* or Whirling Disease)

A) Myxosporidean parasite with a 10 micron oval spore with 2 pyriform polar capsules.

B) Parasite affects primarily young salmonids (rainbow trout most susceptible).

C) Clinically fish become deformed about the head and spine with the fish swimming erratically (whirling). Histologically there is necrosis of the cartilage with numerous spores present in the area of inflammation. The necrosis of the cartilage is the cause of the deformation.

D) Transmission is believed to be by ingestion of spores. The life cycle of this organism is not completely known,(believed to be indirect since myxobolus spores do not directly infect the fish) however, there appears to be a tubificid oligochaetes (tubiflex mud worm) as an important intermediate or transport host. It is believed that the parasite undergoes sporulation in the tubiflex worm were the organism takes on the form of a *Triactinomyxon* sp. It is believed that this parasite is then released from the tubiflex worm and infects the trout. (injection of infected tubiflex worms may also cause the fish to become infected)

● Microsporidians (*Glugea*, *Pleistophora*)

A) **Microsporidian parasites from cysts in various organs. The cysts are filled with small 1 to 2 micron spores. Parasitic cyst may induce hypertrophy of the infected cell (Glugea, Spraguea, and Ichthyosporidium) or does not cause hypertrophy of infected cells (Pleistophora).**

B) **Microsporidian parasites are found in numerous fresh and saltwater fish.**

C) **Clinically microsporidian present themselves as individual or multiple cyst which can become quite large and may give the appearance of neoplasms (xenomas). These cysts are filled with numerous refractile spores.**

1) **Glugea: Infect macrophages and other mesenchymal tissues which then undergo massive hypertrophy causing deformity of visceral organs (liver, gut, ovaries) as well as infections in the muscle and subcutis.**

2) **Pleistophora hypessobryconis (Neon tetra disease): This microsporidian infect the sarcoplasm of muscle fibers causing these fibers to be filled with these organism. There is no inflammatory reaction around the cyst.**

D) **Transmission of the disease is most likely direct.**

● **Coccidiosis**

A) **Primarily of the genus Eimeria. Various species of Eimeria are observed in the different fish.**

B) **Affects both fresh and saltwater fish. The coccidia not only infects the epithelium but also many other organs including the gonads. This is a very important problem in the carp and goldfish culture.**

C) 1) **Eimeria subepithelialis; carp: Nodular white raised areas in the middle and anterior gut.**

2) **Eimeria carpelli; carp: Ulcerative, hemorrhagic enteritis.**

3) **Eimeria sardinae; marine fish: Granulomatous reaction in the liver and testicles.**

● **Hexamita salmonis**

- A) **Binucleated piriform protozoan with 6 anterior and 2 posterior flagella.**
- B) **Infects young salmonids.**
- C) **Clinically the young fish have anorexia, and become debilitated with reduced growth. The fish develop an acute enteritis with numerous organisms present in the feces.**
- D) **Transmission is by ingestion of infective cyst.**

Miscellaneous Parasites

● **Lernea - Anchor worm**

- A) **Copepod**
- B) **Infects all freshwater fish and is a serious problem in cyprinids (bait minnows, goldfish, and carp).**
- C) **Clinically the parasite invades the skin, usually at the base of a fin. The head develops into an anchor that holds the female in place. The female then develops egg sacs (two fingerlike projections attached to the end of the body). The ulcers are slow to heal.**
- D) **Other copepods such as Ergasilus sp. are found on the gills and cause serious gill damage.**

● **Argulus - Fish louse (Branchiura)**

- A) **Parasite of the skin and occasionally bucal cavity.**
- B) **Cutaneous ulcers due to piercing of epidermis by the retractile preoral stylet (a**

proboscis-like mouth).

● **Gyrodactylus sp.**

A) Monogenetic trematode; flattened and leaf-like, no eye spot, cephalic end V shaped, has an attachment organ (haptor) and two large anchors with 16 marginal hooklets.

B) Affects most species of fish.

C) Fluke anchors itself to skin, fins, and gills which may cause excessive mucus secretions over gills and skin. Fish may undergo flashing and have fraying of fins. Severe infection (gills) may cause the fish to become dyspneic and die.

D) Life cycle is direct. The larva are released and attach almost immediately to the host.

● **Dactylogyrus**

A) Monogenetic trematode; flattened and leaf-like, four anterior eyespots, cephalic end scalloped, ova present, has an attachment organ (haptor).

B) Affects most freshwater species, particularly carp and goldfish.

C) Fluke anchors to gills causing excessive mucous secretions, and frayed edges. Fish become anoxic with flaring of the gill opercula.

D) Life cycle is direct. The adults are oviparous and produce eggs with long filaments. The eggs are usually attached to the gills. The eggs develop into a onchomiridium which then attaches to the fish.

● **Diplostomum spathaceum (Eye fluke)**

A) Digenetic fluke; metacercaria is infective state in fish.

B) Gulls and pelicans are the definitive host. Snails (Lymnaea) are the first intermediate host. Fish (salmonids) are the second intermediate host.

C) Clinically the metacercariae are presented as white dots; later the eye becomes opaque. Blindness occurs in severe infections. The metacercariae are found in the anterior chamber, vitreous body, and lens causing cataracts.

● Uvulifer ambloplitis (Black spot disease)

A) Digenetic fluke; metacercariae infect fish.

B) Herons and kingfishers are the definitive host, snails are the first intermediate host. Fish are the second intermediate host.

C) Clinically the fish have numerous black to brown spots up to 1 mm (dia) over the skin, gills and eyes. The spots contain a metacercaria surrounded by heavily pigmented fibrous connective tissue.

● Acanthocephalus (Thorny headed worm)

A) Pomphorhynchus sp. and Acanthocephalus sp.

B) Acanthocephalans are observed in many species of fresh water and marine fish. Adult parasites live in the intestine. The larval second intermediate stage encyst in the liver, spleen or mesentery.

C) Heavy infections are observed in feral fish. Infected fish may not show signs. However, some fish are emaciated and have swollen abdomens. In heavy infections, raised subserosal nodules may be observed in the gut. These nodules may have the proboscis attached. Histologically, a severe granulomatous reaction is associated with the nodules. If the parasite penetrates the serosa a peritonitis may occur.

D) The life cycle is complex involving an amphipod as the first intermediate host. Small fish are believed to be the second intermediate host.

● Anisakis

The parasite causes little problem in fish. However, in man it can be a serious public health threat. Brown and white larva (third stage) are observed in the viscera and musculature of fish. Many marine mammals are the definitive host with this nematode living in the stomach.

Neoplasms

● Melanoma in Platyfish/Swordtail hybrids

Unique invasive melanoma that occurs in the offspring from F1 hybrid platyfish/swordtail with the spotting traits that are crossed with swordtails. F1 hybrids with the spotting trait develop premelanosomes. F1 X swordtail cross will produce frank melanomas. The reason for these melanomas is believed to be due to enhancement of the macromelanophore gene due to a deficiency of modifier genes which leads first to melanosis and finally to invasive melanomas.

● Hepatoma and hepatocellular carcinoma in rainbow trout

These liver neoplasms are associated with aflatoxins in the feed. Acute aflatoxicosis causes acute massive liver necrosis with bile duct proliferation.

● Stomatopapilloma of eels (Cauliflower disease)

These are large firm cauliflower-like masses that are attached to the mouth. Tumors tend to proliferate in the summer and degenerate in the winter. A birnavirus similar to infectious pancreatic necrosis virus has been reported to have been isolated from the affected eel (*Anguilla anguilla*). However initiation of the tumor with cell free extracts has been unsuccessful.

● Papilloma of the Brown bullhead

Papillomas are common in the brown bullhead with occurrence on the head and lip. Viral particles have been observed ultrastructurally in the papillomas, but a virus has not been isolated. Some of these papillomas may progress and become locally invasive squamous cell carcinomas.

● Lip Fibroma (Fibropapilloma) of Angel Fish.

Tumor of the mucocutaneous junction of the lip near the midline. Adult fish that are effected have been females. Tumors begin as small white vesicles that enlarge over several weeks. Tumors are firm, lobulated, and elevate the epidermis. On cut sections the tumors are white with some having cavernous centers filled with clear fluid. Histologically the tumors consist of dense fibrovascular connective tissue arranged in whorls, streams and bundles and covered by a thick stratified squamous epithelium. Cause is unknown; A type "A" Retrovirus has been isolated from affected tissue. Laboratory transmission of the disease to other fish has not occurred.

● Dermal Fibrosarcomas of Walleye pike

Fibrosarcomas are a common neoplasm affecting a large variety of fish. Dermal fibrosarcomas of Walleye pike arise in the dermis and cause multifocal nodules over the entire body. They can be very large and locally invasive. A Type C Retrovirus has been associated with this disease. Occasionally this neoplasm has also been associated with a herpesvirus induced epidermal hyperplasia or lymphocystis disease.

● Lymphosarcoma of Pike

This is an epizootic condition in northern pike and muskellunge in certain regions (i. e. Lake Ontario). The lesion develops as a purple ulcerative cutaneous mass on the head, mouth and flank with invasion into the adjacent muscle and metastasis to spleen, liver and kidney. A type C retrovirus is believed to be the cause of this disease.

● Schwannoma/Neurofibroma's of the bicolor damselfish (Damselfish Neurofibromatosis DNF)

Neurofibromas have been reported in numerous species of fish. The bicolor damselfish has gained notoriety in that some of these fish develop multiple cutaneous schwannomas. This neoplasm is believed to possibly represent an animal model for von Recklinghausen Neurofibromatosis (NF type 1) in man. The similarities and differences between these two diseases are as follows: The primary lesion in both NF type 1 and DNF are neurofibromas, many of which are plexiform in nature. The fish tumors are often malignant. DNF the pigment lesions can be neoplastic and quite invasive, while the cafe-au-lait spots of NF type 1 are benign. NF type 1 appears to be genetically transmitted while DNF appears to be horizontally transmitted.

Nutritional Deficiencies

● Iodine Deficiency

Iodine deficiency cause hyperplasia (goiter) of the thyroid tissue. The cause is not always known. Some may be due to iodine deficiency (very difficult to produce) while others may be due to the affects of goitrogenic substances in the feed or to the presence of goitrogenic pollutants in the water.

● Fatty Acid Deficiency (Linolenic and linoleic acid deficiency)

Fish are capable of synthesizing most fatty acids but not the linolenic or lenoleic acid series. Deficiencies of these fatty acids lead to depigmentation, fin erosion, cardiomyopathy, fatty infiltration of the liver, and myxomatous degeneration of fat.

● Vitamin C Deficiency

Ascorbic acid is an essential vitamin of fish. Deficiencies of this vitamin lead to poor wound healing, ulceration of skin on fins, hemorrhage, and skeletal deformity. This vitamin is very temperature sensitive and oxidizes readily in stored feed.

● Vitamin E Deficiency

Vitamin E deficiency is associated with necrosis and degeneration of skeletal and cardiac muscle, steatitis, and lipoidal liver disease.

● Pantothenic Acid Deficiency

Pantothenic acid is a coenzyme need in the metabolism of fats and carbohydrates. Deficiencies lead to anorexia due to hyperplasia of the gill lamellar epithelium and fusion of secondary lamella (nutritional gill disease). Anemia is usually associated with the disease.

● Methionine Deficiency

Methionine deficiency (primarily in salmonids) leads to reduced growth rate with the development of bilateral cataracts. It is felt that deficiencies of vitamin A and riboflavin also play a role in this lesion.

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