Pathology of Aquatic Species

Disclaimers
- The opinions and assertions herein are those of the authors and do not necessarily reflect the view of the Department of the Army or the Department of Defense.
- Images are credited as possible, however, the authors of many excellent images are unknown, and their contribution to learning is recognized and greatly appreciated.
- No financial remuneration of any kind was obtained associated with this lecture.

Overview:
- Infectious diseases
  - Viral
  - Bacterial
  - Protozoa
  - Fungal
  - Parasitic
- Neoplastic diseases
- Non-infectious diseases

Osteichthyes (Bony fish) and Chondrichthyes (Cartilaginous fish)
- Between 30,000-40,000 species described

Extraordinary fish diversity
Fish pathology:
General concepts

- Necrotizing versus Granulomatous disease
- Variation in leukocytes between species
- 74 bacterial pathogens of fish, dozens of fungi, hundreds of known viruses, thousands of parasites, innumerable toxins and miscellaneous or physiological pathologies.
- Emerging diseases

Viral Infections

- DNA:
  - Herpesvirus
  - Iridovirus
  - Adenovirus
- RNA:
  - Picornavirus
  - Paramyxovirus
  - Reovirus
  - Rhabdovirus
  - Rhabdovirus
  - Bacteriophage
  - Retrovirus
Lymphocystis

Grouper Iridovirus (GIV)

Lymphocystis

Piscine Herpesviruses
- Carp pox herpesvirus (Cyprinid herpesvirus 1, CyHV-1)
- Haematopoietic necrosis herpesvirus of goldfish (Cyprinid herpesvirus 2, CyHV-2)
- Koi Herpesvirus (Cyprinid herpesvirus 3)
- Channel catfish virus (Ictalurid herpesvirus 1, IcHV-1)
- Salmonid HPV-1 and HPV-2

Lymphocytisitis

Pacific Herring
Koi herpesvirus (KHV) is a highly contagious viral disease that may cause significant morbidity and mortality in common carp (Cyprinus carpio) (Hedrick et al. 2000; OATA 2001). The white patches are due to necrosis (death) of the gill tissue. Gill lesions caused by KHV disease are the most common clinical signs in affected koi. Other external signs of KHV may include bleeding gills, sunken eyes, pale patches or blisters on the skin.
Channel catfish

Salmon

Rainbow trout

VHS (Viral hemorrhagic septicemia)

- Affects >50 species of fish (Fresh water and marine)
- Multiple strains
- Family Rhabdoviridae
- Gross: Visceral, cutaneous and muscular petechial hemorrhage
- Exophthalmus, ascites, ecchymoses around eyes, skin, gills and fins

VHS
VHS

Spring Viremia of Carp

Atlantic salmon

Salmon Infectious Anemia

Ulcerative Dermatitis in Winter Flounder

WSSV
Other viral diseases of Shrimp

Bacterial Infectious Diseases
- In zebrafish, the pneumatic duct acts as the primary point of invasion for systemic fungal and bacterial infections, spreading to the gas bladder.
- Primarily opportunistic infections of which the first agents: Aeromonas sp. and Pseudomonas sp.
- Clinical signs of Gram negative septicemia are non-specific and include: ascites, exophthalmia, cutaneous hemorrhages (body and fins), cutaneous ulceration.

Non-specific signs of septicemia
- Ascites or "Dropsy"
- Exophthalmia
- Cutaneous hemorrhages
- Ulceration
Motile Aeromonas Septicemia

Aeromonas hydrophila

Tilapia

Koi Ulcer Disease

Bald sea urchin disease
Aeromonas salmonicida

Goldfish ulcer disease

Yersinia ruckeri

Trout

Enteric septicemia of catfish (ESC)

*Edwardsiella ictaluri

Channel catfish
Edwardsiella tarda

Edwardsiella tarda (Emphysematous Putrefactive Disease EPD)

Renibacterium salmonarium

Renibacterium salmonarium

Salmon

Chinook Salmon
Mycobacteriosis

- Mycobacterium marinum
- Mycobacterium chelonae
- Mycobacterium fortuitum

*Mycobacterium sp.*

*Gliding bacteria*

*Flavobacterium columnare*

*Protozoae*

- Ichthyobodo necator
- Epistyly
Microsporidia

- Glugea, Ichthyosporidium, Loma, Pseudoloma, Microgemma, Microsporidium Mrazekia, Nosema, Pleistophora, Spraguea, Tetramicra, and Theragra.

Microsporidium sp.

Microsporidia masu

Zebrafish

Pseudoloma neurophilia
Glugea stephani

Plaice

Glugea sp.

Cotton Disease

Myxosporidiae

Henneguya salminicola
Myxobolus aeglefini

- Gross Findings: Severe scoliosis, frequently with black discoloration of the tail, and with chronicity, misshapen head and jaws
- Histopathological Findings: Cartilage degeneration and necrosis, granulomatous chondritis with intralesional ovoid to ellipsoidal spores (5-15µm) with 2 piriform-shaped polar capsules at the anterior end

Myxobolus cerebralis

- Gross Findings: Severe scoliosis, frequently with black discoloration of the tail, and with chronicity, misshapen head and jaws
- Histopathological Findings: Cartilage degeneration and necrosis, granulomatous chondritis with intralesional ovoid to ellipsoidal spores (5-15µm) with 2 piriform-shaped polar capsules at the anterior end

Angelfish

Henneguya sp. xenomas

Photos: 65 & 66

Proliferative gill disease

Photos: 76 & 77

Gross Findings: Severe scoliosis, frequently with black discoloration of the tail, and with chronicity, misshapen head and jaws

Histopathological Findings: Cartilage degeneration and necrosis, granulomatous chondritis with intralesional ovoid to ellipsoidal spores (5-15µm) with 2 piriform-shaped polar capsules at the anterior end
Blue/Green Reef Chromis

Ichthyophthirius multifiliis

Ich

Neon tetra

Frogfish

Blue Tang
Channel catfish

Hammerhead shark

Polka-dot Stingray

Parasitic
- Nematodes
- Cestodes
- Trematodes
- Pentastomes
- Arthropods

Nematodes

Eustrongylides sp.
Black spot disease

Trematode metacercariae

Rainbow trout

Diplostomum sp.
Scutariella japonica

Parasitic copepods

Lernaeocera branchialis

Argulus sp.

Pentastomes

Learnea sp.
Ergasilus sp.

Gill maggots

Red Snapper

Spotted-rose snapper

Crabs

Neoplastic
Fish

Fibrosarcoma

Bi-colored Damselfish Schwannoma

Dermatofibroma of Angelfish

Walleye Dermal sarcoma

Walleye Dermal Sarcoma
Northern pike

Flowerhorn cichlid

Arowana

Polka-dot stingray

Seminoma

Cholangiocarcinoma
Papilloma (Cyrinid herpesvirus 1)

Dab

Brown bullhead catfish

Carp

Great White Shark

Reported Zebrafish tumors

- Angiosarcoma
- Adenocarcinoma
- Small cell carcinoma of intestine
- Angiolympoma
- Hemangioendothelioma
- Hepatocellular carcinoma
- Biliary carcinoma
- Hepatoblastoma
- Nephroblastoma
- Renal cell carcinoma
- Thyroid adenocarcinoma
- Ultimobranchial tumor
- Gas bladder adenoma
- Pancreatic acinar cell adenoma
- Pancreatic ductal adenoma
- Islet cell adenoma
- Lymphoma
- Acute lymphoblastic leukemia
- Myxoma
- Fibrosarcoma
- Chordoma
- Hemangioma
- Chondroma
- Myxoid chondrosarcoma
- Medulloblastoma
- Schwanoma
- Sinus lymphosarcoma
- Teratoma

- Myeloma
- Fibroma
- Cholangiocarcinoma
- Choriocarcinoma
- Schwannoma
- Schwanoma
- Hemangioma (Retrobulbar hemangioma)
- Rhabdomyosarcoma
- Hemangioendothelioma
- Hemangiopericytoma
- Chondroblastoma
- Epidermal papilloma
- SCC
- Teratoma
Goiter

Salmon

Gas Bubble Disease

Squirrel fish and Seahorse

Gas Bubble Disease: Supersaturation

Congenital abnormalities
References

- **Histology**

- **Neoplasia**
  5. Dr. Jan Spilbergen POLA notes 2008

- **General**
  6. Registry for Tumors in Lower Animals
  7. Edward Noga, Fish Diseases, Diagnosis and treatment, 2011
  8. Ronald Roberts, Fish Pathology, 2012
  9. Greg Lewbart, Ornamental Fish (Self assessment colour review), 1998
  10. Gary Ostrander, The Laboratory Fish, 2000
  11. Erwin Amlacher, Textbook of fish diseases, 1970
  12. Fish diseases vol 1 and vol 2, (Ed.) J.Eiras et al., 2008