PRINCIPLES OF FISH HEALTH MANAGEMENT: FISH DISEASES, DISEASE PREVENTION AND CONTROL

Bunchong Chumnongsittathum
Tak Inland Fisheries and Development Center,
Department of Fisheries, Thailand

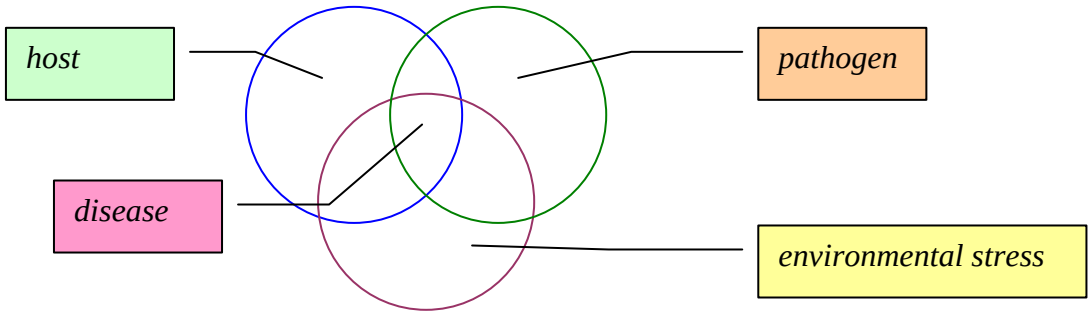
Fishes, like the other animals, are subject to a wide spectrum of diseases. Diseases of fishes require a somewhat different approach to problem solving than diseases involving terrestrial animals. Aquatic animals are in an entirely different environment than the air-breathing animals. Fishes are poikilotermic, and their internal biological systems are tremendously altered by water temperature. Their internal and external biology is also altered by the other physical factors of the environment: pH, osmotic pressure, dissolve gas, ions or elements and others. These factors also determine if an etiological agent (disease-causing agent) can and will cause disease among fishes. Therefore, the fish disease diagnostician must have a broad knowledge of aquatic environment in order to relate clinical findings to disease entities.

Most of the study and report on disease outbreaks were related to fishes from culture systems because of the high stocking density of cultured fish which quite different from the natural environment. The uses of supplementary feed in aquaculture are mostly leading to organic loads in the culture system which might alter water quality making the opportunity on disease outbreak.

CAUSE OF DISEASE OUTBREAK

The occurrences of diseases in fishes are like the other animals, however, the other 3 things are required for disease outbreak more than the *receiving* of pathogens. Snieszko (1974) has described the relationship of host, pathogen and environment as followings:

1. Host susceptibility.
2. Pathogen virulence.
3. Environmental stress.



Host susceptibility means host becomes more susceptible to the pathogen. The weakness during the cultivation may lead to the degree of susceptibility to the pathogen. Moreover, the injury of fish during handling or transportation may open portal of entry of pathogen into the body. The virulence of fish pathogen also increases the degree of outbreak and the mortality of the host. However, the unbalance those factors will not lead to the disease outbreak. Whether host or pathogen is available in the good environmental condition, disease outbreak will not occur. However, the environmental stress is the most important factor leading to the outbreak such as low dissolve oxygen, high fluctuation of water temperature-pH and high toxic elements in the culture system. These stress conditions will lead to weakness of the host and may easily lead to disease infection.

Weakness and injury of the host may be occurred from the improper handling, transportation, nursing, culturing and nutritional deficiency which lead to increase disease susceptibility.

Therefore, the encouragement for good health will decrease the host susceptibility to the disease. Prevention of disease outbreak, the aquaculturist should pay more attention on proper farm management.

Sources of pathogen may come from many sources. The infected fishes from hatchery are the main source diseases. Therefore, fish seed should be come from the certified farm which has routine monitoring program from the certified organization or the farm owner itself. The others are the disease carriers from the natural resources such as fishes, snail, bird, leech, insects, birds and other animals.

Sources of infection

- Infected fish is the primary source of infectious disease.
- Natural fishes and aquatic animals are carrier sources of the disease.
- Infectious water supply.
- Improper feed can lead the parasitic diseases
  - e.g. *Mycobacterium sp.* in water flea.
  - e.g. Nematode can transmit through the feed for carnivorous fish.
- Man and his activity is a good source of infection.

Mode of transmission of the pathogens

- Water supply can transport the microorganism.
- Food is also the mode of transmission.
- Some parasites need intermediate host for transmitting.
- Some pathogenic organism is transmitted by some types of vector.
- Prevention of portal of entry

Portal of entry

- Wound and cut of the host are the way of pathogen to enter the fish.
- Bacteria have particular area for portal of entry.
  - Bacteria can infect membrane of gill, skin and any area.
  - When mucous is broken this will allow the infection.

Virulence of microorganism

- The ability of the pathogen to cause disease from high to low.
- After infection, the bacteria can increase virulence in a short period.

Types of Disease

- Parasitic diseases
- Bacterial diseases
- Viral diseases
- Mycotic diseases

1. Parasitic Diseases

Parasitic Protozoa

Protozoa are animal comprised of a single cell capable of metabolism, reproduction and individual existence. They are the most primitive animals on the earth and have adapted to every possible ecological existence. Protozoa usually present in low numbers on or in fish residing in a natural environment may cause excessive parasitism if great care is not taken to provide suitable habitat and nutrition when the fishes are placed in under culture The epizootics of parasitic protozoa can be observed as the indication that conditions are unsuitable to the fishes in some way but more suitable to the parasite. Taxonomic classifications on investigation of these parasites are described as followings.

- Class Ciliata.
  - *Ciliated protozoa: Trichodina, Trichodinella, Apiosoma,Carchesium, Epistylis, Zoothamnium, Ichthyophthirius, Chilodonella etc.*
- Class Suctoria.
  - *Trichophrya*
- Class Zoomastitophorea .
  - *Flagellate protozoa: Oodinium, Costia, Hexamita, Trypanosoma sp.*
- Class Rhizopodea
  - *Amoeba*
- Class Microspora
  - *spores of unicellular with/without polar filament*
  - *Pleistophora*
- Class Myxospora
  - *spores of multicellular with 2-3 valves, >2 polar filament*
  - *Henneguya. Myxosporus, Myxobilatus, Myxosoma cerebralis (Whirling disease)*
- Class Sporozoa
  - *Haplozoon*

Platyhelminthes (Trematode- fluke worm)

- Monogenea trematode
  - Mostly found on the skin but other habitat found on gill chamber,mouth-body cavity
  - *e.g.* Thaparocleidus *n. sp. Gyrodactylus Dactylogyrus etc.*
- Digenea trematode
  - Complex life cycle; larval generation, alternating sexual and asexual generation
  - Diplost*omum spathaceum; utilized many fish species as secondary intermediate host, fish-eating aquatic birds (sea gull) are primary host.*

Acanthocephalans (hook worm)

- Leptorhynchoides sp.

Cestode (Tape worm)

- Adult stage usually lives in the intestinal tract of vertebrates.
- Intermediate stage lives in the both vertebrate and invertebrate hosts.
- Ribbon shape with divided into segments called “proglottid”.
- *e.g. Bothriocephalus custpidatus* in walleye, *Proteocephalus pinguis* in northern pike, and *Ligula intestinalis* in fathead minnow, yellow perch

Nematode (round worm)

- *e.g. Contracaecum*

Hirudinea

- *Leeches*

Crustaceans

- Anchor worm *(Lernea sp.)*
  - Female becomes adult on the fish host following fertilization by the male.
  - Female metamorphosis complete when the body form of a typical copepod changes to a bizarre creature no longer resembling a copepod.
- *Argulus sp., Ergasilus*

2. Bacterial Diseases

- Gram negative bacteria
  - *Aeromonas hydrophila, A.salmonicida, Flexibacter columnaris, Vibrio anguillarum, Pasteurella piscicida, Yersinia ruckeri*
- Gram positive bacteria
  - *Psuedo*monas fluorescent, Streptococcus sobrinus.
  - *Mycobacterium marinum, M.fortuitum* causes tuberculosis in marine & fresh water fishes.

3. Mycotic Diseases

- Saprolegniasis
  - *Saprolegnia parasitica* – water mold
  - Occur on wound, fish egg
  - *Achlya* and *Aphanomyces*
- *Aphanomyces* previously reported as an external wound pathogen on an aquatic animal was on a fish and also soft shell turtle.
- Found in EUS (epizootic ulcerative syndrome)

4. Viral Diseases

- Caused by DNA or RNA virus
- Lymphocystis
  - disease of connective tissue cells
  - infected cells become hypertrophic – tumour
  - Many freshwater – marine sp. are susceptible.
  - World wide distribution.
- Spring Viremia of Carp (rhabdovirus)
  - Infected in carp, guppy, pike, and grass carp.
  - Mortality decrease below 17 C and above 20 C
  - Cold water period are chronic but warm water period are acute.
- IPNV : Infectious pancreatic necrosis virus
  - Ovarian fluid and feces contain more virus particles.
  - Host: brook trout, rainbow trout, Atlantic salmon
- IHNV : Infectious hematopoietic necrosis virus
- VHSV : Viral hemorrhagic septicemia virus
  - Egtved virus (Rhabdovirus)
  - Host : rainbow trout
- CCVD : Channel catfish virus disease
  - Herpes virus
  - Disease occurs at water temp. 22-28 C (94 % mortality)
  - High mortality in fry and fingerling.
- MrNV : *Macrobrachium* noda virus
- XSV : Extra small virus
  - virus disease in *Macrobrachium rosenbergii*
  - occur in > 10 day old larvae

ENVIRONMENTAL STRESS

1. Water quality

- Improper water quality in physical and chemical may cause stress and weakness of the fishes.
- Sudden change or highly fluctuation of water temperature during a day
- High turbidity of water will decrease surface area of gill lamellae for oxygen consumption.

- Water velocity will affect on the strength of small and big fish in the cage culture.
- pH, alkalinity, dissolved oxygen, carbon dioxide, unionized ammonia, nitrite
- optimum pH 6.5 – 8.5
- Alkalinity = OH^- HCO^-_3 & CO^{2-}_3 75-150 mg./l
- Some fishes prefer the low alkalinity / hardness water.
- The high fluctuation of pH in fish culture pond will relate to low alkalinity and phytoplankton bloom because phytoplankton uses carbon dioxide, carbonate and bicarbonate for photosynthesis.
- The optimum DO during fish culture should be between 5-10 ppm.
- If DO is lower than 3 ppm it will cause asphyxiation or hypoxia for prolong respiratory distress leads to death.
- Associated with muscular necrosis in shrimp; may result to mortality often before dawn.
- Heavy algal bloom may result in super saturation of dissolved gas (oxygen) leading to gas bubble disease. Gas bubble may form in gills, eyes, fin, skin and even in the visceral peritoneum; may result in formation of emboli (in blood) which block blood vessel resulting to gill necrosis and death.
- DO levels depend on number of phytoplankton, zooplankton, aquatic animals, temperature and atmosphere.
- Free CO_2 should not higher than 6 ppm with the excess of DO in culture system.
- Unionized ammonia-UIA (NH_3) should less than 0.02 mg./l depend on fish species.
  - UIA causing gill damage and UIA concentration depend on
    - number of fishes
    - type of foods and feeding rate
    - pH; temperature
    - phytoplankton
- High concentration of nitrite will cause brown blood disease; nitrite will combine with hemoglobin in the blood resulting methemoglobin or methemoglobimia.

2. Nutritional deficiency

- Amino acids deficiency; arginine, valine
- Deficient of tryptophan causes lordosis / scoliosis (body conformation)
- Vitamin deficiency e.g. ascorbic acid, B 6-12, B-complex, Ca
- Rancid feed consume vitamin E (an important antioxidant) in the diet and are toxic. Fatty feed.

3. Receiving some chemicals

- e.g. insecticides, herbicides
- Causing weakness of the host.
- High pathogenic susceptibility.

Clinical sign

- Behavior change
  - spiral movement (whirling disease)
  - no direction
  - Swimming without pattern
  - Scrubbing itself
- Feeding Rate
  - lower
  - No feed
- Coloration
  - Pale or darkening skin
  - 'yellow catfish disease' or 'catfish jaundice'
  - a hemolytic jaundice and anemia caused yellow skin

- Mucous
  - excess *or less*
- Hemorrhage
  - Petechiae (pin point)
  - Larger
  - External / Internal organ/ body cavity
- Wound
- Change of body shape
  - Swelling belly
  - Exophthalmia ; pop eye
- Necrosis
  - Dead cells or tissue
  - Gill rod, fin rod

DISEASE CONTROL

Six methods use for disease control

- Test and slaughter
  - Monitoring the fish routinely.
  - Proper destroy of the infected or dead fish.
- Quarantine and restriction of movement
  - Quarantine to observe the disease of the new arrived fishes for a certain time in the control area.
  - Restrict the movement of the infected fish
- Drug therapy and sanitation
  - Clean the hatchery and earthen pond routinely with proper disinfectant.
  - Use the suitable drug for a certain period.
  - Not all of drug could be used with food fish.
- Immunization and disease resistance.
  - Vaccination can be applied for any disease.
  - Developing disease- resistant stock
- Destruction or reduction of a link in the transmission cycle
- Limitation or control of release of toxic

TREATMENT

There are several ways to treat the infected fish; however, the particular method should to treat with certain disease.

- Dipping treatment
  - Mostly use for external parasitic diseases; use in the hatchery/aquaria
  - All chemicals may harmful to epithelial layer of the skin and gill
  - Formalin 200-1000 ppm for 0.5-1.0 minutes
- Prolong treatment
  - Mostly use for external parasitic diseases ; use in the hatchery/aquaria
  - All chemicals may harmful to epithelial layer of the skin and gill
  - Formalin 75-150 ppm for 30-60 minutes.
  - Salt 0.5 – 1.0 %
  - Acriflavin 10 ppm for 1 hour: for bacterial treatment
  - Acriflavin 1:2500 for 30 min.: egg treatment
- Definite treatment
  - Can be use with parasitic or bacterial disease
  - Formalin 25-50 ppm may cause the DO depletion.
  - Salt 0.1 – 0.5 % or for transportation.

  - Potassium permanganate 3-5 ppm may also cause the oxygen depletion.
  - Acriflavin 2 ppm for bacterial treatment
  - FDA proved chemicals.
- Oral treatment
  - Magnesium sulfate; Mebendazole
    - for internal parasitic diseases
    - Non effective to blood parasites sporozoan, Myxosporidian and Microsporidian
  - Antibiotic for medicated feed ;
    - Oxytetracyclin or Terramycin 3-5 g./ kg. of feed for 7-10 days with quitting period of 14-21 days before harvesting
    - Sulfamerazine 8-10 g./ kg. of feed for 10 days
    - Problem on the non appetite fish; high cost;
- Injection
  - Terramycin 20 mg./1 lb.of fish.
  - Suitable for small group of brood fish
  - Intramuscular / intraperitoneum injection

Chemicals & Drugs

Acriflavin
- Prophylaxis: use for preventing bacterial infection during handling or transportation.
- 1 – 3 ppm
- expensive

Malachite green: zinc free oxalate
- Protozoa treatment 0.1 ppm
- Fungal treatment
- 1:15,000 (66.7 ppm) for 10-30 sec.
- 1:200,000 (5 ppm) for 15 min.
- Ichthyophthirius: 0.1 ppm + formalin 15-25 ppm
- Carcinogen; for non food fish

Lime
- Calcium hydroxide : hydrated lime, slake lime
- 60-80 kg/rai or 350-500 kg./ha
- Calcium oxide : quick lime
- More effective but more risk

Dipterex: organophosphate
- Dylox, Masoten, Neguvon
- Monogenetic trematode & Crustacean treatment
- Lernaea, Argulus , Ergasilus, Leech
- More toxic in high pH water
- 0.25 ppm ; for non food fish

Chlorine: Calcium/Sodium hypochlorite
- Disinfectant
- 10 ppm for pond treatment
- Highly toxic agent; irritate to the skin and respiratory tract.

Iodine: iodophore
- detergent disinfectant for farm premises
- poultry houses veterinary clinics
- food plants and commercial freezers
- Poultry drinking water sanitizer
- Hand sanitizing dip in meat and poultry processing plants

Control Drugs in Food Fish

- Nitrofurazone group
- Chloramphenical
- Oxolinic acid
- Malachite Green
- Insecticides & Herbicides

DISEASE PREVENTION

- Healthy fingerling from certified farm
  - High quality of brood stocks
  - Control of the parasitic diseases that come along with the fingerling.
  - Grow the same age / size of fingerling.
- Sanitation and disinfection
  - Dry and liming the nursery or grow-out pond. (350-500 kg/ha.)
  - Disinfectant; Calcium hypochlorite, Povidine iodine, Iodophore
- Clean water supply:
  - Reservoir
  - Filtration of water before using
  - Disinfection (hatchery)
- Proper handling; proper equipments and techniques in the farm.
- Proper transporting will decrease the stress and injury
  - Size and density of fingerling.
  - Proper temperature and duration during transportation.
  - Suitable vehicle and good traffic.
- Proper stocking density
- Proper feed; quality feed, feeding technique,
- Prevention of carriers, intermediate host and vectors
- Increase the disease resistance
  - Different host(size and strain) has different resistance to certain disease
  - Developing disease- resistant stock
- Monitoring program at proper period or pay more attention on fish behavioral change.