CMFRI

Course Manual

Winter School on

Recent Advances in Breeding and Larviculture of Marine Finfish and Shellfish

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ORNAMENTAL FISH DISEASES AND THEIR MANAGEMENT MEASURES

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Introduction

Aquarium fish industry constitutes an extremely large segment of the pet animal industry. Over two decades, there experienced progressive increase in the ornamental fish industrial productivity both in the domestic market and at International level. Than ever before, more and more indigenous as well as exotic varieties of fishes are being registered into the trade. Primarily being aquatic animals and secondarily being forced to remain under crowded conditions, they are subjected to diseases of varying nature.

There are two broad categories of diseases, which relate directly to selection of appropriate treatments:

1. Infectious or contagious diseases caused by parasites, bacteria, viruses, or fungi. These often require medication to help the fish recover.

2. Non-infectious diseases are broadly categorized as environmental, nutritional, or genetic. These problems are often corrected by optimizing management practices.

Manifestation of an infection or an intense parasite attack is often the result of a primary damage due to unfavourable environmental conditions. Environmental stress decreases the natural resistance of a fish, making it susceptible to diseases. Sick fish alter their normal behavioural pattern in response to a disease agent or environmental changes.

Diseased fishes are recognized by various signs, including:

- increased respiration rate
- scratching on objects or the aquarium bottom
- pale coloration
- refusal to eat
- frayed fins
- appearance of body ulcers
- Cloudy eyes and other signs.

An accurate diagnosis necessitates the gathering of various pieces of information, including water-quality parameters, maintenance data, and close observation of the affected fish's behaviour.

Major Diseases

Disease is a process initiated by reduced resistance of the fish and disruption of the delicate balance involving the fish, the environmental conditions, and the disease agents.

I. Water quality and fish diseases

Water chemistry is the most complicated and most important part of aquarium management. It is necessary to have an understanding of water chemistry in order to successfully diagnose and correct aquarium diseases

a) Oxygen

At least 5 mg/L dissolved oxygen (DO) is needed for most fishes. A DO of less than 2 mg/L is very much stressful and may predispose fish to opportunistic infections. If DO remains below 1 mg/L, most fishes die. In a pond without mechanical aerators, photosynthesis is the most important source of oxygen, for which a certain amount of algae is required. However, too many algae can cause wide fluctuations in DO, as algae are both the major producers and consumers of oxygen in most ponds. A crash or massive death of algae can cause severe depletion of oxygen, exacerbated by great oxygen demand of the decaying algae. The common behavioural signs at low dissolved oxygen include lethargy and congregation of fish near air-water interface (piping). A classical sign of asphyxiation is fish with mouth open and opercula flared. In ponds, clinical signs are most commonly evident in early morning, the largest fishes being most susceptible to oxygen depletion. Meanwhile, in aquaria, air-breathing fish alone survive during such acute environmental hypoxia.

b) Gas super saturation (Gas bubble disease or gas emboli)

Gas super saturation occurs when the total pressure of gases dissolved in water is higher than the atmospheric pressure. This may occur when water is pumped from a deep well, since such water is often supersaturated with nitrogen and / or carbon dioxide. Most gas emboli are produced by excess nitrogen because oxygen is used up and less likely to form persistent bubbles. However, very high oxygen concentrations are dangerous. In ponds that have heavy aquatic plants, photosynthesis may be so great that more oxygen diffuse into water, allowing oxygen to supersaturate the entire pond. If fish breathe supersaturated water, the excess gas may leave solution in the blood stream, forming emboli in various tissues. Tissue hemorrhage and brain damage have been postulated to cause death. Severity of damage depends on the number of emboli formed and the tissues affected.

c) Ammonia toxicity

Ammonia poisoning is one of the most common water quality problems diagnosed in aquaculture. It is the primary nitrogenous waste product of fish and also originates from the decay of complex nitrogenous compounds. In an aquarium, ammonia accumulation is due to an inadequate population of nitrifying bacteria that convert ammonia to nitrate. In a new aquarium setup, these bacteria are very limited. Therefore, when fishes are added to a new tank, ammonia rapidly rises, killing fishes, often referred to as *new tank syndrome*. Ammonia poisoning can also occur due to over stocking or overfeeding. Ammonia is present in two forms: unionized (NH_3) and ionized (NH_4^+) concentrations of which are regulated by pH and temperature.

d) Nitrite toxicity

Nitrite toxicity or brown blood disease is caused by high nitrite concentrations in water. The source of nitrite is metabolic wastes produced by fish when they metabolize protein in their diet. The primary nitrogenous waste product is ammonia. When this is excreted into the water, it is oxidized by ammonia oxidizing bacteria (*Nitrosomonas*) into nitrite, which is subsequently oxidized by nitrite oxidizers to form nitrate (*Nitrobacter*). Nitrite is actively transported across the gill, where it enters the blood stream and oxidizes haemoglobin to methaemoglobin, which cannot transport oxygen and results in respiratory problems. While oxygenated Hb is red, MetHb is brown. Therefore, fish with nitrite poisoning often have brown gills. Affected fish will show signs of oxygen deprivation by pumping their gills excessively and "piping" at the surface for air.

II. Major infectious diseases

Experience has shown that a wide variety of bacterial, parasitic, and other diseases become a problem only if fish are being held under environmental conditions unfavourable for that species or strain.

A. Viral diseases

Although there are relatively few common viruses of aquarium fish, these viruses do cause important diseases, which can result in markedly high mortality in a very short period.

a) Lymphocystis*:*

This is a viral disease characterized by multiple creamy-white nodules on the skin and fins. It is probably the most common viral disease of ornamental fish. Caused by an iridovirus, the disease has been identified in over 100 species of fish. The viral particles cause a marked enlargement of the dermal connective tissue cells resulting in cells up to one thousand times their normal size.

b) Fish pox:

Also known as carp pox or warts, is a chronic skin disease of carp and several related species of cyprinid fish, including ornamental koi. The disease is caused by a virus, but contrary to its name, the causative agent is a herpesvirus, not a poxvirus. Signs of fish pox include the presence of glistening, smooth, flat, milky to tan, slightly raised plaques on the skin surface. The plaques are firm and small, but may join to form larger, irregularly shaped lesions over one inch in size.

c) Spring Viraemia of carp virus (SVCV)

This is cased by a rhabdovirus affecting primarily the common carp, *Cyprinus carpio*. Several other cyprinids and some other species are also affected, and predominantly in the spring. External signs of SVC include skin darkening, swollen belly, exophthalmia, petechial haemorrhage in the skin and gills, anaemia and pale gills as well as protrusion and inflammation of the vent. Shedding of long, white to yellowish and thick mucoid casts from the vent is visible.

d) Koi Herpes virus disease (KHVD)

Koi herpes virus (KHV), a viral disease highly contagious to fish, may cause significant morbidity in common carp (*Cyprinus carpio*). KHV is currently classified as a DNA-virus belonging to the virus family Herpesviridae. Clinical signs of KHV are often non-specific. External signs of KHV may include gill mottling with red and white patches, bleeding gills, sunken eyes, pale patches or blisters on the skin.

B. Bacterial diseases

There are two types of pathogenic bacteria

➢ **Primary or obligate pathogens** – not part of the normal aquatic flora and are capable of causing disease in healthy individuals. Typically, *Aeromonas salmonicida*

➢ **Opportunistic pathogens.** Normally free-living, but become pathogenic under certain circumstances. Typically, *Aeromonas hydrophilia* and *Pseudomonas*.

Some of the more common bacterial pathogens are listed below;

a) Columnaris Disease

This is a common bacterial disease that affects the skin or gills of fresh water aquarium fish, and is caused most commonly by *Flavobacterium columnare* (*Flexibacter columnare, Cytophaga columnare*). Fish with columnaris usually have brown to yellowish-brown lesions (sores) on their gills, skin and / or fins. A characteristic lesion produced by columnaris is a pale white band (often persists as whitish plaques) encircling the body, often referred to as saddle back.

b) Disease caused by *Edwardsiella tarda*

E. tarda has been isolated from a wide range of fish species. The infection manifests itself by the presence of small, 3 to 5 mm red cutaneous lesions located dorso-ventrally on the body. These small lesions progress into abscesses within the flank muscles or caudal peduncle where they develop obvious convex swollen areas and the skin loses

pigmentation. When the skin is incised, a foul smelling gas is emitted and the lesions contain a large amount of necrotized tissue.

c) Fish mycobacteriosis

Fish Tuberculosis is one of the most important chronic bacterial infections, caused by the acid – fast bacteria of the genus *Mycobacterium*. Anorexia, emaciation, and loss of equilibrium, inflammation of the skin, exophthalmia (Pop-eye), ascites (Dropsy), open lesions, and ulceration characterize tuberculosis. Internally, grey-white granulomas (nodules) develop in the liver, kidney, spleen, heart, and muscles. The two species of *Mycobacterium* commonly reported as causative agents in aquarium fish are *Mycobacterium fortuitum* and *Mycobacterium marinum*

d) Motile Aeromonad Septicemia (MAS)

This is an infection caused by several members of motile, Gram negative bacteria of the genus *Aeromonas*, including *A. hydrophila*, *A. sobria, A.caviae,* and *A. veronii*. This disease is also known by other synonyms such as Infectious Abdominal Dropsy (IAD), or Bacterial Hemorrhagic Septicemia (BHS). *A. hydrophila* is one of the most important opportunistic pathogens of freshwater fish. Among the various bacterial pathogens, it is associated with more than one disease, which are manifested by several clinical signs like ulcerations, exophthalmia, abdominal distention etc., which may be considered as common symptoms. Most cultured ornamental fishes are susceptible to infection by *A. hydrophila*.

e) Disease caused by *Aeromonas salmonicida*

Aeromonas salmonicida causes a number of acute to chronic disease syndromes of fish, including furunculosis, goldfish ulcer disease and carp erythrodermatitis. External signs include darkening, lethargy, anorexia, petechiation at fin bases, and a deep necrotic lesion of the skin and muscle, the “furuncle”. The gills are very pale.

f) Mouth Fungus disease

It is caused by the filamentous bacteria *Chondrococcus columnaris*. It is so called because it looks like a fungus attack of the mouth. The symptoms include greyish white cotton wool - like out growths around the mouth area. In serious cases the mouth cannot be closed. It interferes with respiration and prevents the fish from eating

g) Bacterial tail rot and fin rot

Fin rot and tail rot is a bacteriosis from which predominantly the fry and young ones of tropical aquarium fish under captivity conditions generally suffer. It leads to the destruction of the fins especially the caudal fin. This is usually caused by various genera of bacteria such as *Aeromonas*, *Pseudomonas* and Myxobacteria.

h.) Vibriosis

Vibrio infections usually occur in fish from marine and estuarine environments, and have been reported throughout the world. Occasionally, vibriosis is reported in freshwater fish. *Vibrio* infections can spread rapidly when fish are confined in heavily stocked, commercial systems and morbidity may reach 100% in affected facilities. The disease is caused by Gram negative bacteria in the family *Vibrionaceae*. Several species have been associated with vibriosis in fish such as *V. anguillarum, V. ordalli, V. damsela, V. carchariae, V. vulnificus, V. alginolyticus* and *V. cholerae*. The signs of vibriosis are similar to many other bacterial diseases of fish. The common symptoms include lethargy, anorexia, discolouration of the skin, boil-like sores on the body, erythema around the fins and mouth and exophthalmia.

C. Fungal diseases

Primary fungal infections of aquarium fish are considered rather rare. However, fungi can become a problem if fish are stressed by disease, by poor environmental conditions, receive poor nutrition, or are injured.

a) Saprolegniasis

The major fungal pathogen affecting ornamental fishes is Saprolegnia sp. Saprolegniasis is observed as a superficial and chronic infection, with the appearance of cotton wool like tufts on the skin and gills of host fish or eggs. It may spread over the entire surface. It infects almost all aquarium fishes. Microscopic examination shows broad, non-septate (no dividing cell walls) hyphae of varying diameters.

b) Branchiomycosis

Branchiomycosis causes acute, often high, mortality in several freshwater fishes. There are two species, *Branchiomyces sanguinis* and *B. demigrans*. Gills may be mottled in appearance because of areas of thrombosis and ischemia, which cause alternating areas of light and dark regions in the tissue. Histologically, there are branched, aseptate hyphae with intrahyphal, eosinophilic, round bodies.

c) Epizootic ulcerative syndrome (EUS)

Epizootic ulcerative syndrome (EUS) is considered to be an infection with an oomycete known as *Aphanomyces invadans* or *A. piscicida*. This is the only fungal disease listed by OIE. It is an epizootic condition of wild and farmed freshwater and estuarine fish. Parasites and rhabdoviruses have also been associated with particular outbreaks, and secondary Gram-negative bacteria invariably infect EUS lesions. EUS causes disease and mortality in farmed and wild fishes. EUS is transmitted horizontally. The *Aphanomyces* zoospores can be horizontally transmitted from one fish to another through the water supply. It is believed that only the zoospores are capable of attaching to the damaged skin of fish and germinating into hyphae. The most common ornamental fishes affected by EUS include barbs, gobies and gouramies. EUS outbreaks occur during periods of low temperatures and after periods of heavy rainfall. The early signs of the disease include loss of appetite and fish become darker. Infected fish may float below the surface of the water, and become hyperactive with a very jerky pattern of movement. Fish usually develop red spots or small to large ulcerative lesions on the body.

D. Diseases caused by parasites

All fish are potential hosts to many different species of parasites. There are two types of parasites, *ectoparasites* found on the external surfaces such as skin, fins and gills, and *endoparasites* found in the internal tissues and organs. Many parasites require an intermediate host, such as snails, birds or the introduction of an infected fish, and so are rare in pond/ aquarium fish. The irritation caused by ectoparasites often leads to excess mucus production, seen as a grey, slime film, and epithelial hyperplasia, causing respiratory problems if the gills are affected.

1. Diseases caused by Protozoa

Among the most important parasites are the protozoan ectoparasites.

A. Diseases caused by Ciliates:

a) White spot disease/ 'ich' disease

It is caused by a ciliate *Ichthyophthirius multifilis*. This is the fresh water form of the white spot disease. The marine protozoan causing white spot disease is *Cryptocaryon irritans.* It affects the gills and skin. We can see the presence of small (0.5-1mm), white spots / cysts scattered about on the fish's' skin.

b) Trichodiniosis

This disease is caused by *Trichodina* sp. Low numbers are not harmful, but when fish are crowded or stressed, and water quality deteriorates, the parasite multiplies rapidly and causes serious damage. Typically, heavily infested fish do not eat well and lose condition. Weakened fish become susceptible to opportunistic bacterial pathogens in the water.

c) Disease caused by *Chilodonella* sp.

Chilodonella are important ciliate pathogens of a wide range of temperate and tropical fish. The principal signs of infestation are respiratory distress, clamped fins and excessive mucus production, though death can be sudden with minimal signs of disease. It can be easily recognized in skin scrapes and gill biopsies from its characteristic slow gliding movements, often turning in circles.

d) Disease caused by *Epistylis* sp.

Epistylis is the most common and pathogenic type of sessile, colonial ciliate. The colony appears as a white-gray cotton-like patch. It is commonly associated with a mixed infection of gram-negative bacteria known as "red sore" disease. *Epistylis* produces white or haemorrhagic lesions (redness) on the flanks or on the tips of bony prominence, such as the fins, jaws, or gill cover.

***e)* Disease caused by Tetrahymena spp.**

There are a number of species of this genus, which can be parasitic for fish. Diagnosis is based on scrapings and the presence of the parasite. The parasite is teardrop shaped - one end is more pointed. Typically, necrotic lesions and hemorrhaging will be seen on the various parts of the skin. Fins are often also attacked and "patches" may be observed in heavy infections with the naked eye, as they will show a contrasting darker colour. Whitened, eroded areas on the body surface are observed.

B. Diseases caused by Sporozoan parasites

They are a group of spore forming endo parasites, accommodating the largest number of fish parasites.

Microsporidiosis: They are a group of protozoan intracellular parasites.

a) Neon tetra disease

Caused by the microsporan protozoa *Pleistophora (Plistophora) hyphressobryconis*. Even though it is named after neon tetras, it can appear on other fish. The organisms form cysts, which burst and release spores. The spores penetrate further and form more cysts. Finally, the spores migrate to the water and are eaten by other fish in the pond. These spores migrate into the digestive tract, then the muscles and a new infection starts. The spores replace the muscle fibres, appear as white spots on muscles, and thus weakening the fish. The fish begins to loose normal brilliant colour.

Myxosporidiosis- Most of the myxosporidians are less pathogenic but some cause high mortality.

a) Hoferellosis

Hoferellosis or kidney bloater disease is a disease of goldfish and other members of the genus *Carassius*. It is also known as kidney enlargement disease (KED), or polycystic kidney disease of goldfish. The causative agent is *Hoferellus carassii* (formerly *Mitraspora cyprini*). The parasite invades the fish and develops within epithelial (surface) cells lining tubules that make up much of the kidneys. The end result is massive enlargement of the kidneys, recognized externally as swelling of one or both sides of the abdomen.

C. Disease caused by Flagellates

a) "Coastiasis" - Disease caused by *Ichthyobodo* sp.

Ichthyobodo, formerly known as *Coastia,* is a commonly encountered external **flagellate.** *Ichthyobodo* - infected fish secrete enormous amounts of mucus. Mucus secretion is so heavy that farmers popularly refer to the disease as "blue slime disease". Infected fish flash and lose condition, often characterized by a thin, unthrifty appearance.

b) Hole in the Head Disease or hexamitasis

This is caused by a flagellate protozoan *Hexamita* sp. that attacks the lower intestine. Physical signs of hexamitasis include weight loss, decreased activity and anorexia. The infected fish may lie horizontally on the surface of the water with the abdomen visibly distended. Initially small holes appear on the head with a tiny white parasite protruding. In the later stages the holes become larger as the skin is eaten away.

c) Oodiniasis- "Velvet disease"

This disease is caused by other dinoflagellates (*Oodinium limneticum* & *O. pillularis* in fresh water and *O. ocellatum* in salt water). *Oodinium* seems to prefer gills, but heavy infections sometimes cover the skin, eyes, and even inside the mouth. The skin will show "gray" patches which if examined closely will manifest a "dust like" appearance, giving the skin a "velvet" look, which has given rise to an alternative name for the disease.

2. Diseases caused by Metazoan Parasites-Platyhelminthes

a) *Diseases caused by Monogenean trematodes*: Also called flatworms or flukes, they commonly invade the gills, skin, and fins of fish. Monogeneans have a direct life cycle (no intermediate host) and are host- and site-specific. The common signs of fluke infestation include lethargy, piping, flashing etc. Gills may be swollen and pale. *Gyrodactylus* and *Dactylogyrus* are the two most common genera of monogeneans that infect ornamental fishes.

b) *Diseases caused by Digenean trematodes*

Digenean trematodes have a complex life cycle involving a series of hosts. Fish can be the primary or intermediate host depending on the digenean species. The life stage most commonly observed in fish is the metacercaria, which encysts in fish tissues. These digeneans become encysted into gill tissue and respiratory distress is eminent. The metacercariae of *Diplostomum sp* and *Posthodiplostonum* sp. within the skin result in increased melanin deposition, hence the term "black spot disease" or 'black grub'. Visible white or yellow spots in the visceral organs, usually no larger than 1mm in diameter are often referred to as "white grubs" or "yellow grubs", caused by the trematodes *Clinostomum* spp. and *Euclinostomum spp.*

Diseases caused by Nematodes

Nematodes, also called roundworms, occur worldwide in all animals. Small numbers of nematodes may be present in fish without causing significant symptoms. They can infect all organs of the host, causing loss of function of the damaged area. In more severely infected fish, evidence of disease can include emaciation (wasting or significant loss of body mass), nodules or masses present in skin or muscle, stunted growth, abnormal swimming, lethargy, or death.

Three common nematodes affecting fish are *Camillanus, Capillaria* and *Eustrongylides.*

4. Diseases caused by leeches

Leeches are occasionally seen in wild and pond-raised fish. They are annelid worms with segmented body, and provided with anterior and posterior suckers. They have a direct life cycle with immature and mature worms being parasitic on host's blood. Pathogenesis varies with number and size of worms and duration of feeding. Heavily infested fish often have chronic anemia. Fish may develop secondary bacterial and fungal infections at the attachment site. The major genera of leeches include *Piscicola* and *Cystobranchus*.

5. Diseases caused by parasitic crustaceans

Most parasitic crustacea of freshwater fish can be seen with the naked eye as they attach to the gills, body and fins of the host. Two major genera are *Lernaea* and *Argulus.*

a) Anchor worm:

Lernaea, also known as anchor worm is a common parasite of goldfish and koi, especially during the summer months. The parasite attaches to the fish, mates, and the male dies. The female then penetrates under the skin of the fish and differentiates into an adult. Heavy infections lead to debilitation and secondary bacterial or fungal infections. Females have a slender, white, thread-like body, with paired egg sacs trailing from the posterior end.

b) Fish louse:

Argulus or fish louse is a large parasite that attaches to the external surface of the host and can be easily seen with the unaided eye. It attaches to the skin and fins of the fish via suckers and feeds on blood. The feeding activities of argulids are highly damaging to fish. Argulids are also capable of transmitting certain viruses, bacteria, and blood parasites as they feed.

Management of ornamental fish diseases

The control of fish diseases in aquarium systems depend on the prevention of fish disease in fish stocks, good husbandry and rapid diagnosis and treatment of any problems as they arise.

Prevention

Since removal of the pathogen is an unrealistic option, it is important to know how to minimize the risk of infectious disease. In this sense, the application of hygienic and preventive measures of the environment, such as fish health management practices, sanitation and disease control procedures are critical factors to prevent fish disease. For this, fish should be obtained from apparently disease free stocks. New introductions should be quarantined for a period of at least one month during which careful observation and sampling should be carried out. Maintenance of good water quality is of paramount importance. Disinfection of aquaria and equipment may be routinely carried out.

Treatment

A variety of treatments are available, depending very much on the aquarium system in use and the disease being treated. Primarily it should be determined whether the disease is internal or external. Subsequently, its aetiology, whether viruses, bacteria, parasites, or fungi must be confirmed. When internal infections are indicated, one of the few absorbable drugs should be used, medications should be mixed with food or the drug should be injected directly into the animal. Determining fish drug dose must be a careful and precise process. Fish drugs should never be used prophylactically. They should only be applied when there are specific indications of disease.

Viral diseases

There are no specific treatments that will eliminate the virus or cause the skin lesions to regress more rapidly. Fish with skin lesions characteristic of pox should be isolated immediately to limit spread of the disease. Make sure that the fish is eating and provide an environment that is as low in stress as possible by maintaining good water quality. Viral diseases cannot be controlled with medication because they use the host's own cells for reproduction and survival. Provide "good nursing care" for fish which involves maintaining excellent water quality, feeding fish a high quality diet, maintaining clean facilities, keeping sick or potentially infected stock separate from all other animals, and disinfection of equipments.

Bacterial diseases

Maintenance of optimal growth conditions in the pond is indispensable preventive measure against occurrences of both acute and chronic bacterial infections. Antibiotic baths and dips are probably best used for surface disinfections such as fin rot, bacterial gill disease and columnaris (cotton wool disease), where short duration baths with high dosages may be useful.

Antibiotic	Dosage
Bath	
Enrofloxacin	2 mg/litre for five days
Nifurpirinol	66 mg/ litre. Repeat every three days for up to three treatments
Chloramphenicol	10-50 mg/l, as a bath
Oral	
Choramphenicol	50-100 mg/kg body-weight daily
Enrofloxacin	10 mg/kg body-weight daily
Oxytetracycline	75 mg/kg body-weight daily
Injection	
Choramphenicol	40 mg/kg daily
Enrofloxacin	5-10 mg/kg on alternative days 3-5 injections
Gentamicin	3-5 mg/kg on alternative days #
Oxytetracycline	10 mg/kg single dose long-acting preparation

Fungal diseases

Several preventive procedures have been recommended. After stocking a pond with new fish, its surface should be sprayed with 0.15 ppm of malachite green, and the treatment repeated three times at intervals of three days. When infections do break out among fish, therapeutic measures must be used.

Methylene blue: long term bath: 3 ppm

Acriflavine: 0.02 ppm up to 3 days

Protozoan diseases

Effective treatment of protozoan ectoparasites depends on an understanding of the two major types of life styles: nonencysting and encysting. Nonencysting protozoans (e.g., *Trichodina*, *Ichthyobodo*) complete their life cycles on the host and are easily treated, usually with a single, short-term application. Encysting protozoans (e.g., *Ichthyophthirius*, *Oodinium*) produce a reproductive cyst off the host. Both the feeding stage and the reproductive cyst are resistant to treatment, so therapy must be directed at the free-swimming, infective stage. A mixture of formalin and malachite green can be used effectively for controlling protozoan infection. It is formulated by dissolving 3.3g malachite green in 1L of formalin. It is diluted in 1:40,000 (2.5 ml in 100L designated as 25 ppm) or 1:1, 67,000 (1.5 ml in 100L designated as 15 ppm). The higher concentration is used for exposures up to 1 hour, the lower for prolonged treatment. Treat every other day for 3 days. Change up to 50% of the water on alternate days. Remove all plants before treatment. The recommended treatment for *Hexamita* / *Spironucleus* is metronidazole (Flagyl). Metronidazole can be administered in a bath at a concentration of 5 mg/L every other day for three treatments

Monogenean diseases

One important consideration in designing an effective treatment is whether the Monogenean is viviparous or oviparous because the eggs of some monogeneans are resistant to treatment and thus several drug applications may be required for control. The treatment of choice for freshwater fish is formalin, administered as a short-term or prolonged bath Potassium permanganate can also be effective in controlling monogeneans. Formalin: 2-4mL/10mL of water in a separate quarantine tank for 30 minutes.

Digenean diseases

The best control of digenean trematodes is to break the life cycle of the parasite. Elimination of the first intermediate host, the freshwater snail is often recommended. When ponds contain no fish, snails can be treated with quicklime, at 125-150kg /acre pond with water 1 m deep.

Nematode diseases

Antihelminthes can be used as food additives to remove adult nematodes or larvae from the intestinal tract. A common antihelminthic, Fenbendazole can be mixed with fish food (using gelatin as a binder) at a rate of 0.25% for treatment. It should be fed for three days, and repeated in three weeks.

Leech infestation

Leeches can be manually removed from the fish.

Dips in 3% saltwater are effective in controlling leeches.

Ponds with heavy leech infestation require drainage, treatment with chlorinated lime, followed by several weeks of drying. This will destroy the adults and their cocoons containing eggs. Organophosphorus insecticides are popular leech killers. Nuvan (Dichlorvos) kills leeches at 0.125 ppm for indeterminate time. Live plants should be removed and treated with potassium permanganate at 5 ppm before replanting.

Crustacean infestation

Treat the whole tank with the organophosphorus insecticide nuvan (dichlorvos) at the dosage of 0.1 mg/L (continue bath for 7-10 days, may need repeating) to kill juvenile stages. Manually remove adults from fish body. If fishes sensitive to this medication are present, treat them separately with potassium permanganate (10-20 mg/L, 30 minutes bath).

Conclusion

There are many diseases of fish, which can be troublesome to commercial producers as well as the recreational pond owner. There are two broad categories of disease, infectious and non-infectious. Infectious diseases are contagious diseases caused by parasites, bacteria, viruses, or fungi. Non- infectious diseases are broadly categorized as environmental, nutritional, or genetic. Disease is a substantial source of monetary loss to aqua culturists. Production costs are increased by fish disease outbreaks because the investment is lost in dead fish, cost of treatment, and decreased growth during convalescence. A holistic approach should be adapted to the diagnosis, treatment and prevention of disease. This should consider the interaction of the environment, pathogens and host related factors. An accurate diagnosis is fundamental to the selection of an appropriate treatment. The economics, possible side effects and environmental impacts of treatments should be considered before application. Preventive management is the most important step in disease control since a systematic and thorough approach to health management can reduce the incidence of disease and associated production losses. Fish, which do not respond to a correctly administered treatment, should be re-evaluated by a fish health professional.

The following precautions can be taken to reduce the possibility of disease and keep it from spreading if it occurs:

- By only good-quality, compatible fish
- Quarantine new fish before adding them to aquarium (A hospital tank can be used for this)
- Avoid stressing the fish with rough handling or sudden changes in conditions
- Don't overfeed the fish
- Remove sick fish to a hospital tank for treatment
- Disinfect nets used to move sick fish
- Don't transfer water from the quarantine tank to the main aquarium

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