

Disease (causative agent)	Environmental factors involved
<ul style="list-style-type: none"> <li>Furunculosis</li> </ul>	Crowding, handling and low level of dissolved oxygen in water
<ul style="list-style-type: none"> <li>Gill disease (bacterial) environmental</li> </ul>	Crowding, chemical irritants, viz. elevated ammonia excessive particulate matter, low level of dissolved oxygen
<ul style="list-style-type: none"> <li>Columnaris disease</li> </ul>	Crowding, handling and higher temperature
<ul style="list-style-type: none"> <li><i>Aeromonas</i> spp. and <i>Pseudomonas</i> spp. Haemorrhagic septicemia</li> </ul>	Low dissolved oxygen in water, handling, crowding, prior external parasitic infection, unhygienic condition and low temperature of ambient water
<ul style="list-style-type: none"> <li>Gill necrosis</li> </ul>	Over drugging with formalin
<ul style="list-style-type: none"> <li>Eye disease in <i>Catla catla</i> (bacterial)</li> </ul>	Poor sanitary condition of ambient water
<ul style="list-style-type: none"> <li>Dropsy of carps and catfishes (bacterial)</li> </ul>	Poor sanitary condition of ambient water, over stocking and chronic exposure to low dissolved oxygen
<ul style="list-style-type: none"> <li>Parasite infestations (<i>Dactylogyrus</i>, <i>Trichodinid</i> parasites copepods)</li> </ul>	Overcrowding of fry and fingerlings, low oxygen, excessive variations among fish in rearing facilities, excess feed or fertilizers
<ul style="list-style-type: none"> <li>Reddish blotches of <i>Hypophthalmichthys molitrix</i></li> </ul>	Poor sanitary conditions of ambient water over stocking and chronic exposure to low level of dissolved oxygen
<ul style="list-style-type: none"> <li>Tail and fin-rot</li> </ul>	Crowding, low dissolved oxygen, improper diet, chronic exposure at sub-lethal level to contaminants
<ul style="list-style-type: none"> <li>Epithelial ulcerations</li> </ul>	Chronic, sub-lethal contaminant exposure
<ul style="list-style-type: none"> <li>Epithelial tumors</li> </ul>	Chronic, sub-lethal contaminant exposure
<ul style="list-style-type: none"> <li>Skeletal anomalies (scoliosis/lordosis)</li> </ul>	Chronic adverse water quality, vitamin C deficiency
<ul style="list-style-type: none"> <li>Trichodiniasis</li> </ul>	Crowding, low level of dissolved oxygen and high levels of urecolariid ciliates in ambient water
<ul style="list-style-type: none"> <li>Gas embolism</li> </ul>	Super-saturation of O <sub>2</sub> , N <sub>2</sub> in water
<ul style="list-style-type: none"> <li>Exophthalmia</li> </ul>	Deficiency of vitamin B in diet
<ul style="list-style-type: none"> <li>Impaired growth</li> </ul>	Deficiency of essential amino acids in diet, unhygienic condition, low dissolved oxygen, metabolite accumulation in ambient water

Pathogens	Disease/pathological feature
<b>Fish</b>	
<i>Aeromonas salmonicida</i> , <i>A. salmonicida</i> , atypical strain <i>A. hydrophila</i>	Furunculosis Carp erythrodermatitis Haemorrhagic septicaemia, dropsy, skin lesions, Fin rot and tail rot
<i>Vibrio anguillarum</i> , <i>Vibrio</i> spp. <i>Yersinia ruckeri</i> <i>Renibacterium salmoninarum</i>	Vibriosis Enteric red mouth disease Bacterial kidney disease

Pathogens	Disease/pathological feature
<i>Edwardsiella tarda</i> <i>E. ictaluri</i> <i>Flexibacter columnaris</i> <i>Pseudomonas</i> spp. <i>Nocardia</i> spp. <i>Mycobacterium</i> spp. <i>Staphylococcus aureus</i> <i>Clostridium botulinum</i>	Edwardsielosis (Haemorrhage, septicemia) Enteric septicaemia of channel catfish Columnaris disease Septicemia, haemorrhage, eye disease Granulomatous lesions Granulomatous lesions Eye disease Botulism
<b>Shrimp</b>	
<i>Vibrio alginolyticus</i> , <i>V. parahaemolyticus</i> <i>Aeromonas</i> sp., <i>Pseudomonas</i> sp.	Bacterial shell disease
<i>Vibrio alginolyticus</i> , <i>V. parahaemolyticus</i> , <i>V. anguillarum</i>	Septicaemic Vibriosis
<i>Leucothrix mucor</i> , <i>Flexibacter</i> sp., <i>Cytophaga</i> sp., <i>Flavobacterium</i> sp.	Filamentous bacterial disease
Monodon baculovirus White spot syndrome virus	Monodon Baculovirus disease (MBV) White spot syndrome
<b>Prawn</b>	
<i>Vibrio</i> sp., <i>Aeromonas</i> sp., <i>Pseudomonas</i> sp. <i>V. alginolyticus</i> , <i>V. anguillarum</i>	Black spot disease Vibriosis

### Management and surveillance of fish diseases

Fish disease is the culmination of an interaction between the susceptible fish, the pathogen and the environment. An optimum environment always helps in the good growth of fish whereas a bad environment favours multiplication of pathogens. The triad relationship is very evident where stressful environment is an important predisposing factor in the outbreak of infectious disease in fish.

## Indicators of health condition of fish stock

**Escape reflex:** External agitation, viz. quick motion, stamping on the bank, sound etc., causes healthy fishes to quickly submerge under water. Sick fish do not react and can be caught easily.

**Defensive reflex:** A healthy fish caught from water toss about quite violently when placed on ground and calm down after a while. Sick fish are sluggish in water as well as out of it.

**Tail reflex:** When the fish is held by the head and posterior portion is free, it keeps the posterior fin in a horizontal position or even slightly obliquely upward while the caudal fin is always stretched in a fan shape.

## Strategy for preventing disease

A primary objective of rearing fish is to maintain healthy fish populations that are optimally eating, growing and normally functioning. The key to achieving this objective is through stress management, preventing and minimizing stress to fish in the culture environment by understanding and managing the various environmental factors that cause stress. Maintaining fish health is accomplished by individually and collectively managing environmental quality factors as near to optimum for fish as possible essentially within fish range of tolerance.

**Water source:** The source of water in fish rearing facilities is an important aspect of fish disease prevention. The sources of water are mostly rain-water or river water or irrigational canal water or sometimes groundwater. Direct rain-water is always ideal for rearing. Irrigation water is not always ideal. There are chances of harbouring pathogens as it traverses a long distance before entering into ponds. Where river water ingress into fish rearing facilities, the water quality is not ideal. There is possibility of it being loaded with sewage as well as pathogens. Thus to maintain optimum water quality of rearing facilities free of pathogens the incoming water should be first channeled into a storage-cum-filter tank where treatment can be done for settling of organic load and killing off pathogens.

**Disinfection of water:** Maintaining optimum water quality is essential for disinfecting undrainable water areas. *Mahua* oil-cake (*Bassia latifolia*) @ 250 mg/litre is first applied and then limed. It kills the wild fish species, molluscs, tadpoles, frogs etc. and at the same time disinfects and fertilizes the water and soil. **Disinfection of appliances:** Fishing appliances, viz. nets, buckets and hapas, very often serve as carriers of pathogens from one water area to another. To prevent transmission of pathogens, they should be disinfected and dried before use. During fish disease outbreaks, these appliances should be disinfected with 2 mg/litre bleaching powder before use.

**Disinfection off fish:** This is generally done by bath treatment as a routine procedure before stocking in ponds or during sample netting. The chemicals used are 2 to 3% sodium chloride or 20 mg/litre potassium permanganate.

**Stock of fish:** High stocking density of fish frequently acts as a predisposing factor for disease outbreaks. Stocking beyond an optimum level exerts undue pressure on the space, food and oxygen available in the habitat thereby creating stress to fish. Moreover, crowding of fish in an ecosystem results in easy transmission of bacterial, protozoan, monogenetic trematodes and crustaceans parasites from one fish to the other.

**Adequate food:** Optimum amount of food should be present in the ecosystem to sustain the fish population. If natural food is not sufficient, it must be supplemented with good quality and quantity of food.

**Separation of young and broodfishes:** Adult and brood fishes often serve as carriers of various pathogens without exhibiting outward symptoms. They sometimes are survivors of previous epizootics due to built up immunity, but may retain some of the pathogens. Often spawners, after breeding, are kept with fry or juveniles due to paucity of ponds where chances of transmission of pathogens to young ones occur. To avoid such risk young ones should be separated from the brood and other fishes.

**Entry of wildfishes:** Wild fishes are often the carriers of various pathogens, which do not manifest in serious disease outbreak in their native environment. These wild fishes, when they are brought and reared in confined water areas with high stocking density disease outbreak occurs. The parasites causing such outbreaks are the one having direct life-cycle like the parasitic copepods. Fish farmers receiving their water supply from irrigational canals or rice fields often receive wild fish and have a high risk of infections to farmed fishes. This was evident during outbreak of epizootic ulcerative syndrome disease.

**Harmful associated organisms:** These are the intermediate hosts or carriers of various serious pathogens. Snails, copepods or birds serve as intermediate or definitive host of various digenetic trematode and cestode diseases. *Argulus* sp. is reported to serve as vector for other pathogens.

**Raking:** This method of hanging some weight in a rope and dragging it from one side of the waterbody to the other ensures agitation of the bottom muck. This releases the obnoxious gases, viz. ammonia, hydrogen sulphide (H<sub>2</sub>S) and methane (CH<sub>4</sub>), in the form of bubbles upward.

**Introduction of exotic fishes:** Several of the introduced fishes in the country are infected with pathogens. In India, import of various exotic fishes for culture or as ornamental fish is being carried out without restriction or quarantine. Within the country there is continuous transfer of post larvae, fry and fingerlings from one state to the other. Evidences suggest that these movements caused fish disease outbreaks in various parts of the country. To prevent this spread of pathogens quarantine is one of the most important systems of preventing introduction of exotic pathogens or

transporting pathogens from one part of the country to the other. Fish quarantine units supported by legislation should be urgently developed in the country.

**Surveillance and monitoring:** Reports of incidence of fish mortality that occur in open water-bodies are less. The reason for inadequate reporting is that monitoring of such information is yet to find a place in the framework of fish health management practices prevailing in this country.

### **Antibiotic Issue: Rules and regulations**

As per the notification of the Ministry of Commerce and Industries the Maximum Residual Limits (MRL) for pesticides, antibiotics and heavy metals in the marine product of the country as follows:

Antibiotics	MRL
Chloramphenicol	Nil
Furazolidone	Nil
Neomycine	Nil
Nalidixic acid	Nil
Sulphamethoxazole	Nil
Tetracycline	0.1 ppm
Oxytetracycline	0.1 ppm
Oxolinic acid	0.3 ppm
Try methopprime	0.05 ppm

The MRL for antibiotics and pharmacologically active substances prescribed by EU and USA, particularly with reference to banned substances (i.e. MRL Nil), have been identified for ready reference are all nitrofurans including Furaitadone, Furazolidone, Furyfuramide, Nifuratel, Nifuroxime, Nifurprazine, Nitrofurantoin and Nitrofurazone. Thus, fish and fishery product processors, exporters are prevented from exporting products ontaining residues in excess of the MRLs prescribed by the importing country.

Source: Hand book of Fisheries and Aquaculture, ICAR, New Delhi