

Appendix 3 – Fish pests and disease control

As discussed in Section 7.6.3, disease is the result of an imbalance between the fish, the pathogen/causative agent and the environment. Weakness in the animal and higher incidence of the pathogen in certain environmental conditions more favourable for the pathogen causes disease. Sound fish management practices that build a healthy immune system are the primary actions to secure a healthy stock. Fish diseases must be recognized and treated expediently. The following two tables outline symptoms and causes of common diseases, separated as abiotic and biotic, to highlight the importance of water quality and environmental conditions in disease identification.

Abiotic diseases	
Hypoxia	<p>Symptoms: fish piping, gathering at water inflow, depression or anorexia (chronic hypoxia), larger fish die with smaller fish alive, dead fish with opercula and mouth widely open.</p> <p>Causes: insufficient aeration, aeration breakdown, overcrowding, low water flow, reduction of dissolved oxygen (increased temperatures or salinity).</p> <p>Remedies: restore/empower aeration, reduce stocking density, reduce feed, monitor levels of ammonia and nitrite.</p>
Temperature stress	<p>Symptoms: lethargy, mortality of cold intolerant (hypothermia) or hot intolerant (hyperthermia) fish, mould disease (hypothermia), dyspnea (hyperthermia).</p> <p>Causes: lack of heating or insulation, breakage of thermostat, improper management.</p> <p>Remedies: insulate the tank, add a water heater, house the system in a greenhouse in cold seasons (hypothermia). Shade the tank wall, ventilate at night, setup a cooling system (hyperthermia).</p>
Ammonia poisoning	<p>Symptoms: abnormal swimming, not feeding, darker gills, larger gills (hyperplasia, for chronic toxicity), redness around eyes and fins.</p> <p>Causes: new tank syndrome, biofilter failure (various causes, also for antibiotic or antiseptic treatments to fish if carried in aquaponic tank), biofilter media recently washed/cleaned, tank overcrowding, excessive supply of feed, excessive protein in feed, reduced water flow, reduced oxygen in water, temperature drop inhibiting nitrifying bacteria.</p> <p>Remedies: immediate water exchange (20–50%), addition of zeolite (quick remedy, but low efficacy at higher salinity), reduction of pH with acid buffer, add bacteria, add biofilter media, improve oxygenation, adjust temperatures to optimal levels, stop feeding.</p>
Nitrite poisoning	<p>Symptoms: difficulty in breathing, darker gills, brownish blood, abnormal swimming such as gathering near the water surface, lethargy, redness around eyes and fins.</p> <p>Causes: new tank syndrome, biofilter failure (various causes, also for antibiotic or antiseptic treatments to fish), biofilter media recently washed/cleaned, tank overcrowding, excessive supply of feed, excessive protein in feed, reduced water flow, reduced oxygen in water, temperature drop, low Cl:NO₂ ratio.</p> <p>Remedies: immediate water replacement (20–50%), add bacteria, add biofilter media, reduce fish density, stop feeding, add chloride, improve oxygenation, adjust temperature to optimal levels, avoid fish disturbance as it causes acute mortality.</p>
Hydrogen sulphide	<p>Symptoms: characteristic smell of rotten eggs, presence of purple-violet gills, unusual swimming behaviour of fish.</p> <p>Causes: solid waste accumulation with anaerobic conditions, lack of adequate aeration, increase of temperature.</p> <p>Remedies: removal of organic wastes accumulating in anaerobic conditions, remove fish to a recovery tank until the cause has been removed, increase DO in water, increase pH, lower the temperature.</p>
pH	<p>Symptoms: low pH: acute death with trembling and hyperactivity, difficulty in breathing, increased mucus production. High pH: opacity in skin and gills, corneal damage (not common).</p> <p>Causes: low pH: nitrification occurring, low buffer in water, improper acid addition. High pH: improper buffer addition, water too rich in alkalinity/hardness. Too much carbonate in biofilter media or carbonate leaching from concrete tanks.</p> <p>Remedies: water replacement, buffer addition, add base or acid to adjust pH. In case of low pH adjust with base only if the level of ammonia is very low (risk of unionized ammonia at high pH), in case of high pH add distilled/rainwater.</p>

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Abiotic diseases	
Improper salinity	<p>Symptoms: skin lesions, depression.</p> <p>Causes: salinity concentrations beyond fish tolerance, replacement of water with sources with higher/lower salinity, miscalculation of salt addition (saline species), evaporative loss causing higher salt concentrations in the remaining water.</p> <p>Remedies: add deionized/rainwater or freshwater to decrease salinity, add salt to increase salinity. Addition of salt should not exceed 1 mg/litre increment per hour.</p>
Gas super-saturation (gas bubble disease)	<p>Symptoms: fish floating to surface, popped eyes due to gas emboli, presence of emboli in blood and any organs, including eyes, skin and gills.</p> <p>Causes: rapid increase of temperature or rapid decrease of water pressure that reduce the gas solubility, use of groundwater, excess water oxygenation.</p> <p>Remedies: reduce the gas in excess, avoid stress to animal during recovery.</p>
Food deficiency	<p>Symptoms: poor growth, depression, mortality, abnormality in the skeleton, ocular lesion, anaemia.</p> <p>Causes: food lacking in essential elements, improper storage of feed, lack of feed variance, low ration, blindness, excessive fat accumulation.</p> <p>Remedies: follow the fish requirements, vary the diet, provide specific pellet feed for fish, provide vitamins and minerals, balance protein:fat ratio and decrease fat (fat accumulation).</p>

Source: Modified from Noga, 1996 – See Further Reading section for full reference.

Bacterial diseases	
Columnaris (peduncle disease, fin rot, cotton wool disease, black patch necrosis)	<p>Symptoms: reddening and erosion of skin turning into shallow ulcers and necrosis, necrosis of gills, release of yellowish mucus from the lesions.</p> <p>Causes: main agent <i>Flexibacter columnaris</i>. Concurrent causes from acute stress, increase of temperatures, low oxygen, nitrite. Above 15 °C increases pathogenicity.</p> <p>Remedies: prolonged immersion in potassium permanganate to treat fish initially and increase appetite to let them eat medicated feed. Immersion in copper sulphate. Antibiotic treatment (oxytetracycline, nifurpirinol), in separate tank. Eliminate the underlying causes.</p>
Dropsy	<p>Symptoms: infection of internal organs leading to fluid accumulation in the body. The fish appear bloated.</p> <p>Causes: various bacteria, although it can be caused by parasites or a virus. Concurrent causes are also weakened fish and inadequate water/environmental standards.</p> <p>Remedies: treatment of fish with medicated feed containing antibiotics (chloramphenicol, tetracycline) in a separate tank. Elimination of water/environmental causes.</p>
Fin rot	<p>Symptoms: damaged fins with fin ray exposed, erosion, loss of colour, ulceration and bleeding. Internal septicaemia.</p> <p>Causes: bacterial infection from different agents, but <i>Pseudomonas</i> spp. more recurrent. Poor water conditions, bullying from other fish. Often pathogenic at low temperatures.</p> <p>Remedies: identify the cause(s). Treat the fish in a separate tank by providing medicated feed with non-resistant antibiotics (chloramphenicol or tetracyclin) or dissolve the antibiotic directly in the water. Keep separated until full recovered.</p>
Streptococcosis	<p>Symptoms: acute haemorrhages on body, popped eyes. Presence of sanguineous liquid in peritoneal cavity.</p> <p>Causes: <i>Streptococcus</i> spp.</p> <p>Remedies: treatment with antibiotics (oxytetracycline erythromycin, ampicillin).</p>
Tuberculosis	<p>Symptoms: emaciation, lethargy, lack in appetite, hollow belly. Skin presents ulcer, loss of scale and fin erosion. Appearance of yellow or dark tubercles on the body. Presence of 1–4 mm white nodules in internal organs especially on kidney and spleen.</p> <p>Causes: the bacteria responsible are <i>Mycobacterium</i> spp. but overcrowding, poor water quality and susceptible fish species are supplementary causes. Ingestion is the most common transmission factor. Encysted bacteria can survive two years in the environment.</p> <p>Remedies: extended treatment with erithromycin, streptomycin or kanamycin and Vitamin B-6 or elimination of the fish. Attention is required when handling as the disease may be transmitted to people.</p>
Vibrio	<p>Symptoms: skin haemorrhagic with reddening spots in the lateral and ventral part of the fish, swollen lesions turning in ulcers releasing pus. Systemic infection in kidney and spleen. Eye lesions such as eye cloudiness, ulceration, popped-out eyes and eventually organ loss. Additionally anorexia and depression.</p> <p>Causes: various type of <i>Vibrio</i> spp., more common in brackish-water and tropical fish. Increased incidence with higher temperatures. Concurrent factors in stress, crowding, organic pollution. In salmonoids, <i>V. anguillarum</i> outbreaks appear in temperatures below 5 °C.</p> <p>Remedies: timely treatment with antibiotics (oxytetracycline, sulfonamides) due to the very fast course of the disease. Reduction of stress is fundamental for long term control of the disease. Attention required when handling, as the disease may be transmitted to people.</p>

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Fungal diseases	
White cotton saprolegnia	<p>Symptoms: white, brown or red cottonish growth on fish surface, expanding. Ocular lesions as cloudy eyes causing blindness and loss of the organ.</p> <p>Causes: <i>Saprolegnia</i> spp. often as an opportunistic agent following other infections and overall fish weakness. Concurrent causes in acute stress, temperature drop, transport stress.</p> <p>Remedies: prolonged salt bath or formalin bath, treatment of eggs with hydrogen peroxide or prolonged immersion in methylene blue. Lesions may be treated with cloth soaked with povidone iodine or mercurochrome.</p>
Protozoan diseases	
Coccidiosis	<p>Symptoms: intestinal infestation and enteritis, epithelial necrosis. Lesions on/in internal organs such as liver, spleen, reproductive organs and swim bladder.</p> <p>Causes: Coccidia belonging to different families.</p> <p>Remedies: use of coccidiostat monensin, sulfamidimine (1 ml in 32 litres water; repeated weekly) or amprolium.</p>
Hexamitosis	<p>Symptoms: occurrence of parasite in intestine and gall bladder or other organs in more advanced cases. Presence of abdominal distension and white, mucous excrements followed by behavioural disorders such as fish hiding in corners with head down and/or swimming backwards, progressive reduction of head volume above the eyes and darkening of body.</p> <p>Causes: <i>Hexamita</i> spp. <i>Spironucleus</i> spp. flagellate protozoa attaching the intestinal tract. Affects debilitated and stressed animals.</p> <p>Remedies: use of Metronidazole both in the feed (1 %) and in the water (12 mg/litre). Addition of magnesium sulphate as a cathartic. Increase temperature and improve environmental conditions.</p>
Ich/white spot	<p>Symptoms: small white cysts (up to 1 mm) covering the body of the fish giving an appearance of salt grains that emerge, mucous skin, skin erosions. Behavioural disorders seen as lethargy, loss of appetite, and body rubbing against walls in the attempt to remove the parasite.</p> <p>Causes: <i>Ichthyophthirius multifiliis</i>.</p> <p>Remedies: the parasite is susceptible of treatment during the free-swimming stage of juveniles (theronts) following the adult stage on the fish (trophont) and the production of cysts (tomont) that fall on the bottom. Treatment with salt bath or formalin bath every week until cured. Maintain water temperature above 30 °C for 10 days. Raising the temperature from 21–26 °C shortens the cycle of the parasite from 28 to 5 days making the treatment period in curative bath shorter.</p>
Trichodina	<p>Symptoms: a wet mount (microscopy) of skin scraping will show the parasite. A grey film on skin and gills, along with an excess of white mucous secretion. Anorexia and loss of condition in heavily infested fish.</p> <p>Causes: saucer-shaped protozoan parasite that attaches to gills and the body surface of the host fish. Often found in poor water quality and overstocking.</p> <p>Remedies: formalin or potassium permanganate bath. Salt or acetic acid bath immersion (freshwater protozoa only).</p>
Velvet/Dust	<p>Symptoms: brownish dust covering the body and/or the fins. Respiratory discomfort (out-of-breath) with quick gill movement due to presence of parasite on the gills, cloudy eyes. Formation of cysts that discharge free infective parasites.</p> <p>Causes: <i>Piscinodinium</i> spp. a parasitic skin flagellate that binds to the host.</p> <p>Remedies: disease is highly contagious and fatal. Raising temperatures at 24–27 °C speeds up the cycle for treatments. Leaving the system with no fish for two weeks to remove the protozoan. For heavy infestation a bath with 3.5 % salt for 1–3 minutes is effective to remove the trophonts. Alternatively, treatment with copper sulphate at 0.2 mg/litre in a separate tank, repeated as necessary. Copper can bioaccumulate and cause toxicity.</p>
Parasitic diseases	
Anchor worm, lice	<p>Symptoms: presence of parasites on skin, gill, mouth. Erosion and ulceration. Red spots on skin that can raise up to 5 mm.</p> <p>Causes: copepods of various origin, introduced from the wild.</p> <p>Remedies: identifiable with magnifying lens, extended treatment in salt (freshwater species). Also hydrogen peroxide, formalin and ivermectin are remedies for lice.</p>
Flukes	<p>Symptoms: scraping on tank walls, release of mucus from gills, fast gill movement, gill and fins damages. Paleness, quick respiration and flopping fins.</p> <p>Causes: flatworms about 1 mm long infesting gills and skin. Detectable with magnifying lens.</p> <p>Remedies: treatment of 10 to 30 minute bath in 10 mg per litre of potassium permanganate in a separate tank (freshwater parasite only). Salt bath (freshwater parasite only). Formaline or copper bath.</p>
Leeches	<p>Symptoms: presence of parasites on the skin creating small red or white lesions. Heavy infestations lead to anaemia.</p> <p>Causes: external parasites mainly introduced from wild.</p> <p>Remedies: avoid introduction of raw plants or snails, bath in salt solution, use of organophosphates.</p>
Nematoda	<p>Symptoms: progressive loss of weight, lethargy, void bellies and accumulation of parasites around the anus. Colonization of viscera with 0.6–7.0 mm worms in the intestine.</p> <p>Causes: threadworms infesting all over the body but are visible when they concentrate at the anus. Infestation occurs with introduction of wild or pond fish.</p> <p>Remedies: medicated feed with fenbendazole oral, levamisole oral.</p>

Source: Modified from Noga (1996) – See Further Reading section for full reference.