Fish Culture Technical Bulletin
Best Management Practices

DISEASE PREVENTION IN THE FISH CULTURE FACILITY

"Prevention of disease outbreaks is more cost effective than treating dying fish."[1]

Disease outbreaks only occur in a fish culture station when three conditions are present:

1) A susceptible host
2) A virulent pathogen
3) Adverse environmental conditions which cause stress

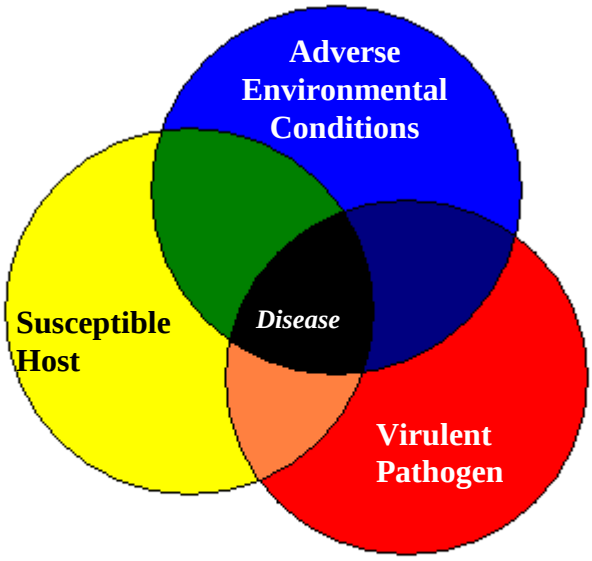

Figure 1. This diagram illustrates the relationship between the components of a disease outbreak at a fish culture station.

AVOIDING STRESS: NATURAL DEFENSE IN FISH[1,2]

Fish have several features that act as natural barriers to pathogens and injury. If these features are in some way compromised, then the defense system of the fish is as well. Mucus (the slime covering of the skin of fish) acts as the first physical barrier. It also acts as a chemical one, as it contains enzymes and antibodies. Injury to the fish can remove this mucus leaving the fish more susceptible to disease. The scales and skin of the fish act as a secondary physical obstacle whose utility is reduced if scales are lost or the skin is damaged. A fish's immune system can vary in

efficacy. Fish that are raised in sterile environments may have few antibodies, while those that have been naturally exposed to low-levels of pathogens may have a wide variety of antibodies and a much stronger immune system. Water temperature can have a profound effect on immune system response. Low water temperatures may reduce the response of the immune system. Higher than optimal temperatures may make it difficult for the fish to fight infection and may encourage growth of the pathogen population within the fish.

The five main causes of stress are the following:

1) Poor water quality
2) High densities of fish in tanks
3) Improper handling causing injury
4) Poor nutrition
5) Poor sanitation

Water conditions and stocking density

Optimal water quality conditions should be maintained at all times. Parameters such as oxygen, TGP (total gas pressure), pH, alkalinity and temperature (see "natural defense in fish") are to be checked regularly to ensure that they are appropriate to the species being cultured. If possible any and all fish known to be infected by pathogens in the intake water supply should be eliminated. Oxygen levels should never fall below 6 mg/L (6 ppm) at the outflow and the carrying capacity of the tank should not be exceeded. Carrying capacity is defined as the total amount of fish weight which any individual rearing unit may hold based on the quantity of oxygen available and is influenced by unit size, fish species, fish size and water flow rate as well as water quality parameters. It is important to note that rearing densities vary with species of fish (refer to Bulletin 2004-04 “Fish Husbandry During Early and Advanced Rearing). Crowding of fish can cause injury and loss of mucus to occur along with increasing the impurities in the water. Waste should not be permitted to accumulate: dirty water has the potential to promote the conditions that favour pathogens.

Movement and handling of fish

A large portion of stress experienced by fish in hatcheries is due to unnecessary or improper handling and fish transfers. Once cleaning and feeding are completed, activity levels around the tanks should be kept to a minimum. Lighting should be minimized whenever possible. When performing inventories, grading or intra-station transfers it is imperative that fish be handled efficiently and with care. The tanks should be cleaned and feeding stopped the afternoon prior to the day the fish are to be moved (a minimum of 18 hours). When fish are to be transported for stocking feeding should cease 48 - 72 hours prior to the transfer. Crowding of the fish, if needed, should be done using screens. Dip nets and/or tubs must never be overfilled as this can cause fish to be crushed or smothered; it is preferable to transport or weigh fewer fish at one time. Ice may

be used on occasion to prevent rising water temperatures when fish are leaving the station to be stocked. Blocks of ice may be placed in trays above the water level or crushed ice may be placed directly into the tank. However, ice must NEVER be made with chlorinated water. Transfers should coincide with monthly inventories so that fish are disturbed as little as possible. Also note the following:

- Avoid knotted nets - they are less likely to cause injury;
- Tubs/containers ought to have smooth corners and seams;
- Transfer water should be highly oxygenated;
- Salt solutions of 0.3%-1.0% may be used to minimize osmotic stress ;
- Movement of fish should ideally occur when fish are least susceptible to infection (e.g., when temperatures are cool); and
- If available, use of a fish pump is recommended to minimize fish handling.

Nutrition

Feed should be stored in an area where it is least likely to be accessed by pests such as mice. The expiration dates on the feed should be adhered to. Preferably, the area should be cool and dry to prevent decay or breakdown. Feeding rates should be monitored closely to ensure fish are not being overfed. See Bulletin 2004-4 for feeding details.

Sanitation[2,3]

In order to prevent the entry of pathogens into a hatchery or fish culture station stringent sanitary practices must be observed.

Staff and visitors

If proper precautions are not taken, hatchery staff and visitors to the station can easily introduce and/or transmit pathogens from one section of the station to another. Foot baths should be placed at entrances to each section of the hatchery, as should dispensers with antibacterial hand sanitizer. Foot baths and hand sanitizers must be used to restrict the possible entry of pathogens. Antibacterial hand sanitizers are easily obtained commercially; for foot bath solutions see below. If possible the movement of staff between different areas of the facility should be limited. If not, staff should move “downstream” (from younger fish to older fish and/or source water to outflow) through the facility while performing daily assignments. Special care should be given to staff movement in and out of brood stock areas. Disinfection of hands and feet must occur when passing from one area of the facility to another. If the hatchery contains a quarantine or isolation unit, it should be the last area entered each day.

Equipment and rearing units

All incoming equipment (vehicles, transportation tanks, etc.) must be thoroughly disinfected. Each tank or unit of fish requires its own set of cleaning utensils and mortality pickers to avoid any cross contamination. The floor should be kept clean and any feed that is spilt removed so that it does not attract rodents, promote mold and bacteria growth or spread to other areas of the hatchery. Auto feeders and feed hoppers should be cleaned and floors washed regularly.

For disinfection of equipment and hatchery utensils there are numerous commercial sanitizers which are readily available for:

- surface sanitization -
- vehicle sanitization
- sanitization of all equipment (personal - boots, rubberized aprons and waders; general - nets and brushes)
- foot baths – which should be refreshed every 2-3 days depending upon usage

The following is a list of commercial products currently used at MNR FCSs and their purpose(s):

- A-Quat (equipment disinfection, foot baths)
- A-456-N (equipment disinfection)
- Alcohol Aloe Vera Hand Sanitizer
- Biomaxx International Waterless Hand Sanitizer
- Fectol (foot baths, equipment disinfection)
- First Response Instant Hand Sanitizer
- Lysol No Rinse Sanitizer (formerly Roccal) (foot baths, equipment disinfection)
- Purrell Hand Sanitizer
- PVP Iodine (foot baths)
- Quatromycide (equipment disinfectant)
- Rocco (foot baths, equipment disinfection)
- Virkon (foot baths, equipment disinfection, in spray form for hand sanitizer)
- Wescodyne (equipment disinfection)

Mortalities[4]

Fish should be monitored closely, particularly at feeding time. Note any abnormal behaviour that may be indicative of health problems or disease. To avoid fungal growth and possible pathogen transfer all dead fish should be removed immediately upon discovery. The fish are to be placed in a bucket containing disinfectant. Following the completion of removing all dead fish the contents of the bucket should be placed in the freezer for later off-site disposal. Dead fish should NEVER be kept near live ones. Fish must be taken to a rendering plant if possible. If not, then permission of a landfill operator should be obtained and the fish buried in the landfill. Fish should NEVER be buried on the site of the fish hatchery given that they may be unearthed by scavengers or

contaminate nearby waters. Fish should NEVER be flushed down the toilet, passed down standpipes or released into any other effluent water

Following the emptying of a tank or rearing unit the entire unit must be systematically disinfected to prepare for the next lot of fish.

[1]Rottman, R. W., R. Francis-Floyd and R. Durborow. 1992. The role of stress in fish disease. Southern Regional Aquaculture Center Publication No. 474. 3 p.

[2]Iwama, G. K., C. Y. Cho and J. D. Hynes [Eds.]. 1981. Handbook of Fish Culture. Fisheries Branch, Ontario Ministry of Natural Resources. Toronto, Ontario.

[3]Ontario Ministry of Natural Resources. 1999. Fish Culture Course 1999 - Manual. Fish Culture Section, Ontario Ministry of Natural Resources. Peterborough, Ontario.

[4]Ontario Ministry of Natural Resources. 2003. Draft Manual of Fish Health Protection in the Ontario Provincial Fish Culture System. Unpublished draft. Fish Culture Section, Ontario Ministry of Natural Resources. Peterborough, Ontario. 46 p.