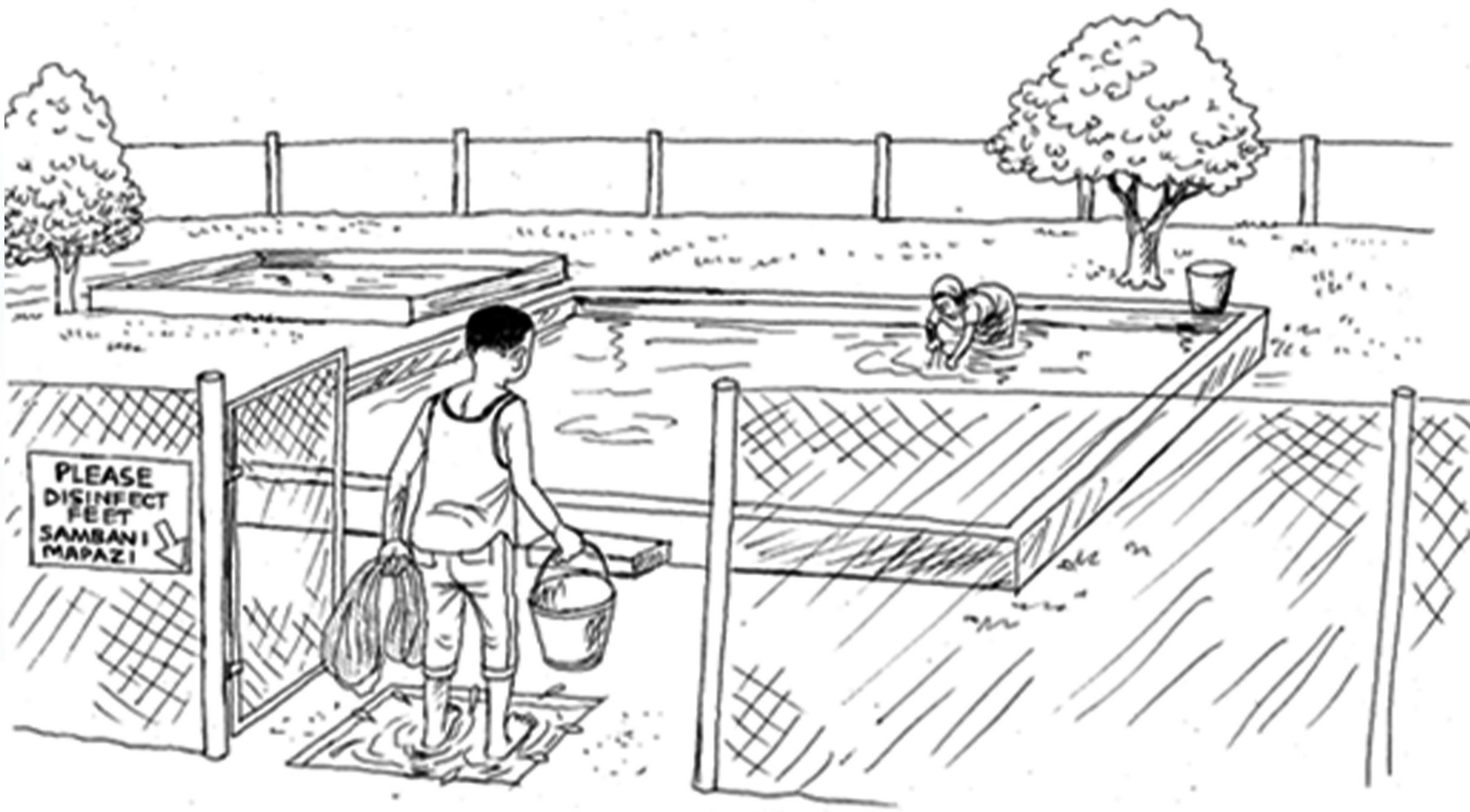



# FISH HEALTH AND MANAGEMENT

Module III of 8

# Fish Health and Management

Module III

# FOREWORD

The growing demand for fish in Malawi and the Southern African Development Community (SADC) region requires additional efforts by the governments to increase fish production from aquaculture. All Malawi's development policies (Malawi Vision 2063, Malawi Growth and Development Strategy III 2017-2022, National Fisheries and Aquaculture Policy 2016, National Aquaculture Strategic Plan 2021) emphasise the need to promote aquaculture development in order to enhance production from aquaculture to supplement the dwindling capture fisheries production and cannot satisfy the ever increasing demand for fish. The development policies also emphasise the need to pursue sustainable practices and climate smart technologies.

Up until now, there were many reference materials which extensionists from both government and non-governmental organisations have been using to train farmers in aquaculture principles and practice. These manuals, however, were not coherent, often providing conflicting recommendations and were not vetted by the Department of Fisheries under the Ministry of Forestry and Natural Resources as proper training materials for aquaculture. Hence, it is timely that this new aquaculture manual has been developed for use in the aquaculture practice. This manual will become a nationally recognised tool for training in aquaculture practice.

The target users of this aquaculture manual are extensionists from government and non-governmental organisations, fish farmers and trainers of these groups. The manual contains technical information as well as training plans to help the trainers to conduct training in an orderly manner.

The Ministry of Forestry and Natural Resources remains committed to foster the development of aquaculture in the country for nutritional and food security, income generation and job creation.

**Yanira Ntupanyama, PhD.**
**Secretary for Forestry and Natural Resources**

# PREFACE

This Technical Manual for Trainers on Good Pond Aquaculture Practices has been developed to address the gap that existed when the country did not have a universal, nationally recognised manual as basis for training our extension agents, fish farmers and for use by non-government organisations engaged in the aquaculture sub-sector. This manual will be a reference material for guiding aquaculture practices in Malawi. Accordingly, the manual has been developed to support the implementation of the National Fisheries and Aquaculture Policy 2016 which highlights sustainable aquaculture development as policy priority number 2 and the National Aquaculture Strategy (2021-2029).

There are several challenges that exist in the aquaculture sub-sector that need to be addressed for the benefit of fish farmers and extension workers. The major challenges include: lack of harmonised approaches and information to guide all players in the value chain, inadequate supply and access to inputs i.e. quality fingerlings and feed, unavailability of market structures to aggregate production and measures to increase the resistance of the sector against risks related to climate change.

It is expected that this aquaculture manual will become the necessary tool for all actors along the aquaculture value chain mainly for technical know-how regarding aquaculture production. Where possible, trainers or users may be guided by the aquaculture experts from the Department of Fisheries under the Ministry of Forestry and Natural Resources.

**Friday Njaya, PhD.**
**Director of Fisheries**

# ACKNOWLEDGEMENTS

The Department of Fisheries (DoF) in the Ministry of Forestry and Natural Resources is grateful to all stakeholders, too numerous to mention, who contributed to the development of the nationally recognized Technical Manual for Trainers on Good Pond Aquaculture Practices. The DoF acknowledges the financial and technical support from the Aquaculture Value Chain Project for Higher Income and Food Security (AVCP) funded by the German Federal Ministry for Economic Cooperation and Development (BMZ) and implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ).

The Department also acknowledges the efforts and technical contributions from all the government officers, academicians, technicians and practitioners who took part in the development of this manual. Thanks should also go to the team that finally edited the manual.

Special recognition and gratitude are extended to the GIZ Food and Nutrition Security Program (FNSP) for contributing the chapter on nutritional benefits of fish and all individuals who were involved and contributed in the development of this manual.

# INTRODUCTION

Fish predation which is defined as the consumption of one organism in whole or in part by another, while the consumed organism is alive, is one of the biggest challenges faced by farmers. Various kinds of animals prey on fish leading to severe losses to farmers' harvest. And aquatic insects if not properly controlled can cause a lot of damage to fish eggs, larvae and fry in ponds, tanks or hapas. Predators also bring about fish stress and a stressed fish is prone to pathogen and disease attacks. Some of these fish predators act as hosts for pathogens and fish diseases. Parasites and fish diseases bring about economic losses in fish farms and hatcheries.

Cultured fish are often confined to an environment to which they are not biologically accustomed, a circumstance that often increases susceptibility to infectious disease. Infectious diseases of cultured fish pose significant constraints to expansion and realization of aquaculture's full potential. Viral, bacterial, and parasitic agents infect many wild and all cultured fish species. Most pathogenic agents are endemic to natural waters where, under normal conditions, they cause no great problem. However, when these same diseases occur in an aquaculture environment they may cause significant disease and mortality. This is why it is important to source broodstock and fish seed from reliable sources to prevent introduction of fish diseases in our farms.

For the purpose of this module on fish health and management; predators, their negative impacts and their control has been covered. Different fish parasites, their negative impacts on cultured fish have been explained. On fish diseases, types of diseases, causes, prevention and control have been explored and their economic importance has been explained. A special mention of EUS which has had negative effects in some fish ponds and natural water bodies has been made. Biosecurity measures and their importance have been highlighted

# CONTENTS

# Predation Control

1

## Introduction

Predation in fish farms can lead to heavy economic losses through loss of fish or introduction of pathogens and diseases. Predators can feed on fish, feed on feeds where were meant for fish, take space meant for fish. They act as hosts for some pathogens and diseases. Predators can also cause economic losses as they can eat almost all fish from pons, tanks and hapas. As losses can either be of the actual fish through predation and theft, or death due diseases, predators must be prevented at a fish farm. This chapter is therefore discussing common fish predators and their control. This chapter will cover on types of predators, their negative impacts and how to control them. This will help the farmer to realize both the economical and nutritional benefits of fish.

### Aim

The aim of this chapter is improve participants' knowledge and understanding on the main fish predators, their impacts on fish production and also improve skills how to control them.

### Objectives

- Participants know
  - Different types of predators
  - The negative impacts of predators

  Acquired skills
  - Basic ways of preventing and controlling predators
  - Calculating fish loss per production cycle

- Acquired attitudes
  - Predation are a threat to fish production

- Relevance to fish production
  - Prevention and control of fish predators will lead to increased yields and fish production which translates to improved income for aquaculture farmers and all those involved in the value chain

- Session Overview: This chapter has one session on Fish Predators and their control

- Materials: Flip- chart paper, markers, study notes, posters – images of predators

- Mode of delivery: Lectures, group discussions and practical
- Duration : 60 minutes

## 1.1 Predator control

### 1.1.1 Predator identification and control

Predation control is among the most important things whether in conditioning, holding, breeding, nursing and grow out ponds, tanks or hapas. Screening must be observed in all culture facilities. Screens work well in not allowing fish eggs and other unwanted things entry into culture facilities. Keeping fish culturing facilities free from weeds and having them fenced would minimize presence of predators. Possible predator preventions must not only be applied when the situation lead to severe losses of fish in our farms.

We have to remember that predators:

- Consume fish in the ponds, tanks and hapas,
- Consume the fish's feed
- May transmit parasites and other infections to fish
- Scare fish when they are chasing them up, and cause physical injury to several fish in the process of hunting.
- May trans-locate fish to a different pond
- Takes fish's space like frogs
- The wounded fish left in the pond consequently have difficulties to feed as the other normal fish. This might be as a result of impaired their eyes, fins.
- Injured or their open wounds might get infected, etc. Consequently, their growth rate slows and chance of survival drops. Controlling predators is therefore important in commercial production.

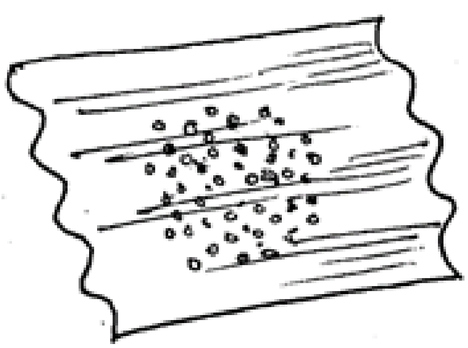


Fig 1.1 Sheets used as screens

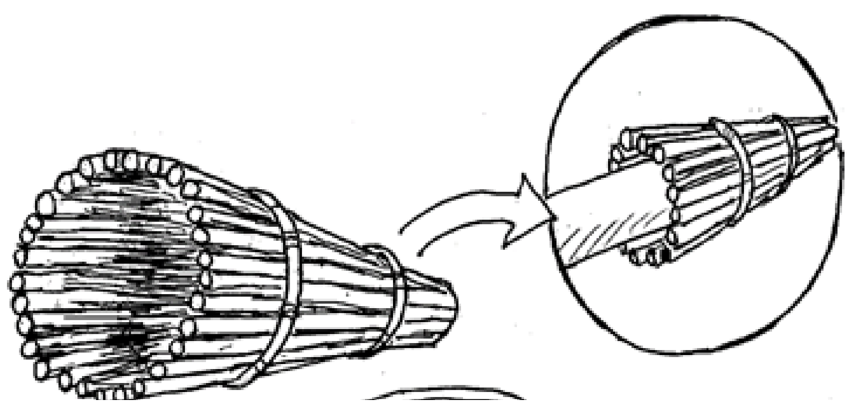
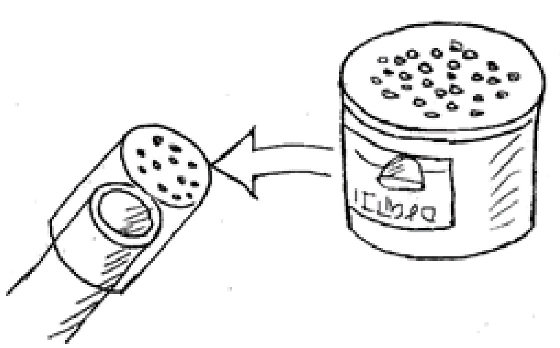


Fig 1.2 Bamboo or reeds can be made as pond inlet screens



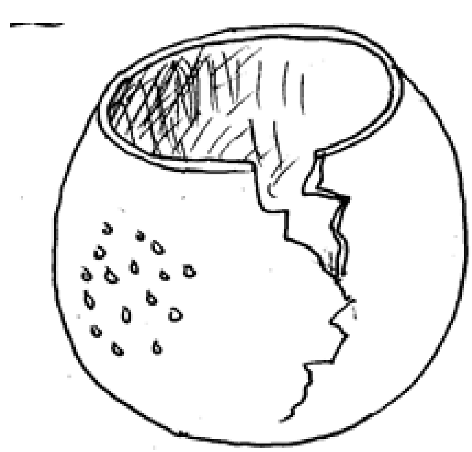


Fig 1.3 & Fig 1.4 Locally available materials like tins and clay pots can be used as screens

**On water quality, we have to know that**

Predators like otters bring about turbidity in ponds thereby reducing the water quality. In the process, fish are stressed up by breathing suspended solids which clog in their gills leading to poor growth due to poor water quality and even death as they can't breathe good dissolved oxygen in the water. Fry and juveniles are the worst hit when turbidity is high in ponds as gills are clogged with pond mud.

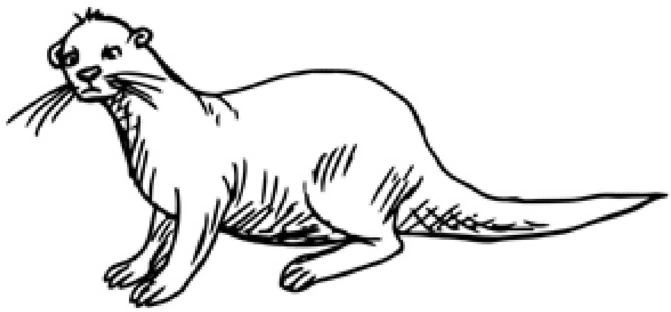


Fig 1.5 Otters, a threat to fish farming

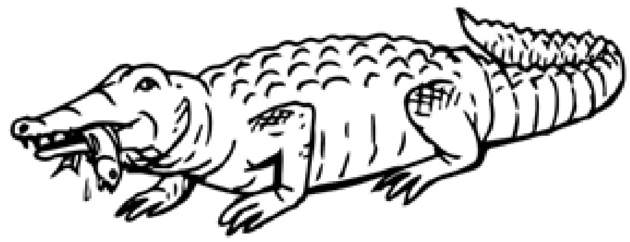


Fig 1.6 Alligators are challenge in some areas

### 1.1.2 Common predators and control

Controlling predators is important in commercial aquaculture production. There are different ways of controlling and preventing predators like trapping, netting or scaring. Shooting can be used as the last resort in cases of birds, crocodiles and otters but in consultation with the relevant authorities. Be very careful when poisoning predators, humans and non-target animals can be affected.

Fig 1.7 Aquatic insects predates on eggs and larvae

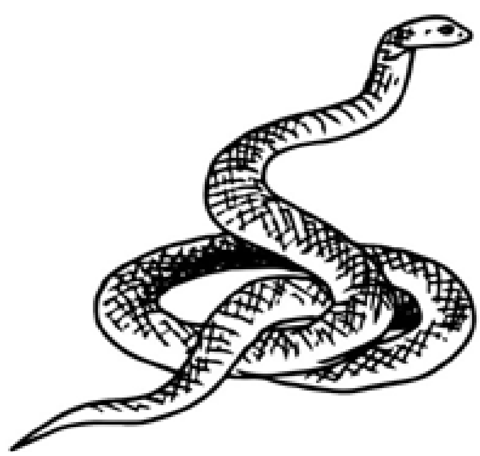


Fig 1.8 Snakes eats all sizes of fish

Table 1.1 Common predators and their control

| **Type of Predator & Effect** | **Possible control measures** |
|---|---|
| **Monitor lizard**<br>- Prey on small and large fish<br>- Causes losses in ponds, tanks, hapas | - Proper pond fencing and setting traps on their tracks<br>- Filling all holes around pond area<br>- Keeping dense bush down.<br>- Keeping dogs at the farm |
| **Otters**<br>- Prey on large fish at night<br>- kills more than what they can eat<br>- Causes heavy losses in ponds | - Proper pond fencing and setting traps on their tracks<br>- Put fences in ponds only allowing fish to pass<br>- Keeping dense bush down<br>- Guarding by using dogs<br>- Putting flood lights in pond areas |
| **Birds (herons, fish eagle, cormorants)**<br>- Prey on all sizes of fish<br>- Eats fish during the night or day<br>- Causes heavy losses<br>- Are home for pathogens<br>- Competes on fish feed | - Construct ponds close to houses<br>- Stretch strings across the pond<br>- Bird scare crows (tins, bamboo rattlers)<br>- Proper pond fencing; Proper fish feeding to avoiding attracting birds,<br>- Cover tanks with mesh or fish nets |
| **Predatory (Carnivorous) fish**<br>- Large number of catfish and tilapia in a polyculture can cause damage<br>- Haplochromis species are destructive<br>- Eats eggs, larvae, fry and fingerlings or nay fish smaller than their mouth | - The stocking density of predatory fish should be low i.e. 10% of the non-predatory fish<br>- Screens should put in inlets to avoid their entry<br>- Liming of ponds after harvesting to kill unwanted eggs and remaining fish<br>- Fish sampling and grading helps eliminating predatory fish |
| **Snakes, Crocodiles, Alligators, turtles**<br>- Eats all types of fish<br>- Snakes Destroys larvae and juveniles | - Proper pond fencing, Having dogs around the farm<br>- Dense bush to be cut down<br>- Having ponds closer to house for closer monitoring<br>- Putting mesh around the pond for snakes and turtles |
| **Frogs and tadpoles**<br>- Generally eats eggs and small fry both for tilapia and catfish<br>- Competes for space and feed<br>- Causes mortalities during sampling or grading | - Proper pond fencing<br>- Clear bushes around and within the ponds<br>- Use traps to catch frogs<br>- Scoop fry and tadpoles from pond edges and destroy them<br>- Liming before pond restocking<br>- Howling them with fish nets and kill them |
| **Crabs**<br>- Feeds on fry and fingerlings cause severe damage in nursery ponds.<br>- Digs pond dykes, leads to heavy pond seepage and breaking of ponds<br>- Burrows holes where other predators do hide. | - Crabs can be controlled by physically removing them from the ponds.<br>- Seal all holes after pond draining and compact the dykes<br>- For heavy seepage, cut a width of 30cm of the pond dyke reaching the pond bottom. Make a core trench to control the seepage |
| **Aquatic insects**<br>- Attack early ages stages of fish, eggs, larvae and fry<br>- Causes heavy losses in breeding ponds and nursery ponds, tanks and hapas | - Filled water in nursery ponds before stocking with fry; (say less than 10 days before) in order to prevent the development of harmful insect larvae.<br>- Excess vegetation must be removed.<br>- Drying the pond after each harvest kills most insect larvae; apply quicklime at 380 g/m2 of pond bed.<br>- Oil emulsion in pond water to prevent aerial breathing<br>- Keep pond dry before refilling<br>- Pond liming |
| **Humans (Theft)**<br>- Can cause a lot of fish loss<br>- They usually use fish traps, hook and line, seine or mosquito net and unauthorised draining and sometimes poisoning. | - Extremely difficult when employees are involved<br>- Ponds should be sited near a homestead to control theft.<br>- Dogs are helpful in checking and chasing thieves<br>- Fencing of pond areas, electric fencing, burglar alarms<br>- Putting flood lights<br>- Frequent visits to ponds can help |

### 1.1.3 Catfish – Predation Control measures

Catfish is cannibalistic and it predates on other species and even younger ones of their same species. To control catfish predation, a monoculture of catfish is recommended and a continuous size grading of fingerlings. If catfish is stocked in polyculture with other species, the size of catfish at stocking should be smaller than the other species and also the catfish should be few, i.e., should comprise only 10% of the total fish stocking density.

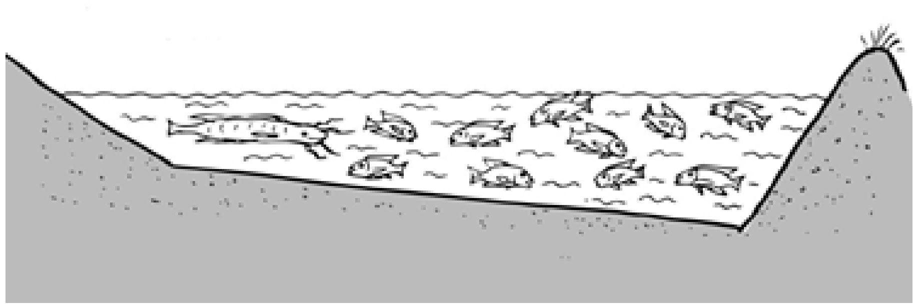


Fig 1.9 Stocking catfish at 10% total fish stocking density in a poly culture

Some preventive measures to follow

- Drained ponds should be thoroughly dried out and disinfected before restocking. However, sometimes this is impossible and many predatory fish species can survive in dump mud for a long time due to their ear-breathing accessory organs (e.g Clarias). Other fish species can come back through un-hatched eggs which can get covered in dump mud in the pond. They can all be killed by quicklime CaO at 1000kg/ha in shallow water.

- In non-drainable ponds, predatory fish can be trapped, netted or caught with baited long lines

- When refilling ponds, the inlet pipe or pump should be screened to avoid unwanted fish or amphibians entering the pond or tank.

- Many predatory fish are migratory e.g catfish and will walk over the land during rain storms. This makes them hard to keep away from ponds. Nylon mesh fencing around nursery ponds can help but they do not last long. Fencing of ponds can help.

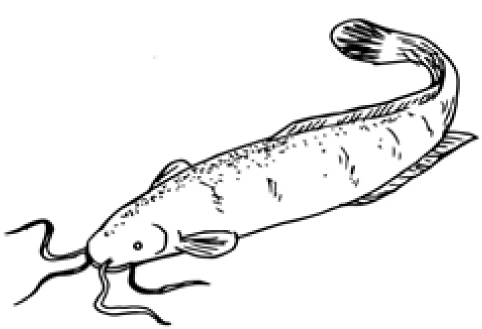


Fig 1.10 Catfish eats any fish smaller than its mouth hapas

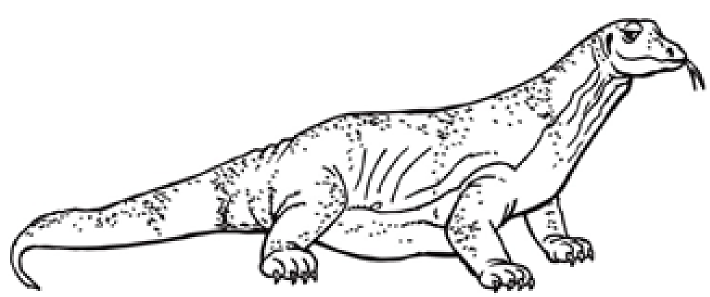


Fig 1.11 Monitor lizards, eats fish even from

## 1.2 Negative impacts of predators

- Economic losses due to reduction in fish population
  Any commercial aquaculture enterprise has one main thing in mind and this is profit. Any aquaculture venture which will lead to many losses is not worth pursuing. Fish predation can therefore lead to huge economic losses as they will result in less fish being harvested against the initial stock. A good percentage will happen to be eaten or stolen by predators and thieves.

- Economic losses due to poor fish growth
  Predator will lead to poor fish growth thereby making losses at the end of the production cycle. Any feed which a fish feeds is used to supply energy to the body and the excess feed is used for its growth. Predators in a pond, tank or hapa like frogs compete with the fish on any available feed which might be given to the fish. If for example you are feeding 100g of feed per day to your fish in a pond or tank which has a 20% population of frogs in the pond or tank, you will be underfeeding your fish as a good percentage of the feed will be eaten by the frogs. This will lead to poor growth and poor yields at the end of the production cycle.

- Economic losses due to pathogens
  Predators in a pond or tank like otters, monitor lizards, predatory fish or birds, forces fish to use a lot of energy for escaping and hiding. This stresses fish and reduces their growth as energy is spent on escaping rather than on growing. For good economic returns, it is important to look at growth not only on an individual basis but the whole stock. Any mortality caused by predators brings about economic losses.

Fig 1.12 Heron slowly walks in ponds eating fish

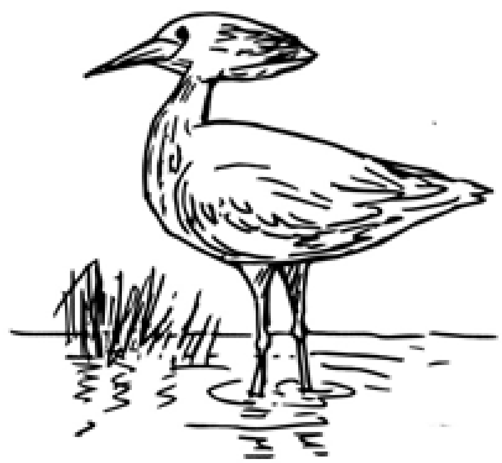


Fig 1.13 Hamerkop eats fish in ponds

## 1.3 Practical – On calculating fish and feed losses

### 1.3.1 Impacts of catfish in a fry and fingerling holding pond

- First scenario
  Assume that there are ten (10) catfish each weighing 150g in a fish seed pond, tank or hapa stocked with 5000 fish seed. Each catfish is eating 5 fish seed per day; calculate the amount of fish seed to have been eaten in 30 days.
  - Number of catfish = 10
  - Seed being eaten per day per catfish = 5
  - Total number of fish seed eaten per day = 50
  - Total number of fish seed to be eaten in 30 days (30 x 50) = 1500

- <u>Second scenario</u>

  Assume these fish seed were to be sold at MWK30/seed, calculate the economic loss assuming that would have been incurred
  - Number of fish seed lost = 1500
  - Selling price per seed = 30
  - Total economic loss (1500 x30) = 45 000

### 1.3.2 Impacts of predation in grow out ponds

- <u>First scenario</u>

  Calculate the loss that an imaginary farmer incurred in a grow-out fish pond with four 400m2 ponds stocked at 5 fish/m2 for one cycle (say 6 months). It should be assumed that 5 birds (Pelican) are eating 5 fish each, per day. Calculate the amount of fish that could be lost (1) per day, (2) after 180 days.
  - Total pond area stocked with fish seed (4 x 400m2) = 1600m2
  - Total number of stocked fish at 5fish/m2 (1600 x5) = 8000
  - Number of pelicans = 3
  - Number of fish being eaten per day by a pelican = 5
  - Total number of fish eaten per day by pelicans (3 x 5) = 15
  - Total number of fish to be eaten in 180 days (180 x 15) = 2700

- <u>Second scenario</u>

  Now in the scenario above, assuming that the average weight of each fish was 200g at harvest, calculate the amount of kilograms lost from the four ponds? Calculate the economic loss assuming that fish is being sold at Mk2500/kg
  - Number of fish lost due to predation = 2700
  - Average weight (g) of each fish = 200
  - Would be total weight (g) at harvest (200 x 2700) = 540,000 (540kg)
  - Price per kilogram (MWK) = 2500
  - Economic loss after 180 days (2500 x 540) = 1, 350,000

- <u>Third scenario</u>

  Now assume that this second scenario is happening for 3 years with two production cycles in each pond, with the amount of fish lost, calculate the number of production cycles that could be lost. Calculate the fish weight in kilograms and the amount of money assuming fish is being sold at Mk2500 per kg

### 1.3.3 Impacts of predation on fish feed loss

- <u>First scenario</u>

  Calculate the loss that an imaginary farmer incurred in a grow-out fish pond with four 400m2 ponds stocked at 5fish/m2 for 30 days. Fish is being fed at 5% average body weight. Assuming that the fish has an ABW of 50g, calculate the amount of feed being fed. If 20% of the feed is being eaten by frogs and birds, calculate the amount of feed lost in 30days.

- <u>Second scenario</u>

  Using the scenario above; calculate the value (MWK) of the feed lost in the 30 days. Assuming that a kilogram of feed is selling at MWK100/kg, calculate the amount of money lost on feeds through predation.

## Summary

Predators are a major threat to aquaculture development in Malawi. They lead to economic losses as they eat fish, competes on feed and space with fish. Predators can be hosts for disease causing pathogens. They cause injuries to fish and wounded fish left in the pond consequently cannot get to the feed as other normal fish. Consequently, their growth rate slows and chance of survival drops. Controlling predators is therefore important and this can only be done through good aquaculture practices.

Looking at the several calculation that have been, it clearly shows that predation leads to losses. It is therefore important to take necessary measures to prevent fish predation at all stages from breeding to harvesting. Prevention of fish predators will lead to increased yields and production which would translate to improved income for aquaculture farmers and all those involved in the value chain.

Things to remember on predators:

- Consume the fish in the pond, tanks, hapas
- Consume fish's feed
- Takes fish's space like frogs
- May trans-locate fish to a different pond
- May transmit parasites and other infections to fish
- They scare the fish when they are chasing them up,
- Cause physical injury to several fish in the process of hunting.

. Predation could be controlled by:

- Locating ponds near homesteads and regular activity at the pond site reduces risks of predation
- Screening of the water inlet keep wild fish and eggs away from the pond
- Ponds should be kept fertile at all times so that fish are not easily seen by predators such as birds
- Draining, drying and liming ponds after harvesting destroys harmful organisms like insects, frogs and tadpoles.
- Keeping the surrounding clear of long grass and aquatic weeds
- Nursery ponds should be filled with water shortly before stocking with fry, (say less than 10 days before) in order to prevent the development of harmful insect larvae.

# Fish Health

## Introduction

Fish provides significant livelihoods and nutritional security benefits in Malawi, contributing as much as 4% of the national GDP and 20% of protein and micronutrient supply to millions of people, many of them among food insecure populations. With the increased population and fish demand, there are efforts to increase small and large scale aquaculture production from 3600 tons to 10, 000 tons. However, as with other intensive production systems, infectious diseases are some of the main issues threatening the success and sustainability of tilapia and catfish production in the country.

Fish diseases are recognized as some of the biggest challenges for the sustainable development of aquaculture in the country. As aquaculture is a business, good profits are necessary for the sustainability of the enterprise. For one to make good profits from an aquaculture enterprise, diseases must be carefully prevented at all costs. Diseases can make a farmer lose an entire production at the farm. As fish health is influenced by three factors; the environment, stress and pathogens (diseases), the chapter is looking at the importance different types of fish diseases, their causes and how to prevent them. Good management practices towards maintaining good fish health has been presented. Fish parasites have been explained.

## Aim

The aim of this chapter is to improve participants' knowledge and understating on the basic principles of fish diseases, types of diseases and enhance skills on how to prevent and treat parasites and diseases in aquaculture.

## Objectives

- Participants know
  - The factors that cause fish diseases in aquaculture
  - Importance of preventing fish parasites and diseases
  - Different types of common fish diseases
  - The basic preventive and control measures;
  - Importance of biosecurity and biosecurity measures

- Acquired skills
  - Basic ways of preventing and controlling fish parasites and diseases
  - Calculating fish loss per production cycle
  - Identification of fish diseases;

- Acquired attitudes
  - Control and prevention of fish parasites and diseases requires careful planning and following good aquaculture practices.

- Relevance to fish production
  - Fish free from parasites and diseases respond well to feeds and grows better
  - Expenditure on fish disease treatment can be avoided with good management practices
  - Fish free from parasites and diseases are easily accepted on the market leading to higher profits

- Session Overview: This chapter has two sessions
  - Session 1: Fish Health and Management
  - Session 2: EUS
- Materials: Flip- chart paper, markers, study notes, posters– images of infected & uninfected fish.
- Mode of delivery: Lectures, group discussions and practical
- Duration : 60 minutes

## Session One

### 2.1 Fish health management?

The expansion of the aquaculture industry comes along with various kinds of fish health problems therefore diseases remain the greatest challenge. It is necessary then that farmed fish have good health and prevention is the best method to achieve this. Fish diseases occur in fish farms where outbreaks may either begin suddenly, progress rapidly usually with high mortalities up to 90%, or disappear with equal rapidity (acute). Sometimes diseases can develop more slowly with less severely but persist for greater periods (Chronic). Fish health management is a term used in aquaculture to describe management practices which are designed to prevent fish diseases. An effective and successful fish health management process starts with prevention, followed by prevention rather than treatment. Prevention of fish disease is achieved through good water quality management, feeding, nutrition, and sanitation. This is the foundation to preventing and controlling possible outbreaks of opportunistic diseases.

### 2.2 What is a disease?

A disease is an association between a pathogen and a host, in this case a fish. A simple contact between the fish and a potential pathogen leads to a disease. Usually other circumstances must be present for acute disease to develop in a population. These circumstances are generally grouped under the umbrella term, "Stress" Fig 2.1. Management practices directed towards at limiting stress are likely to be more effective in preventing diseases outbreaks.

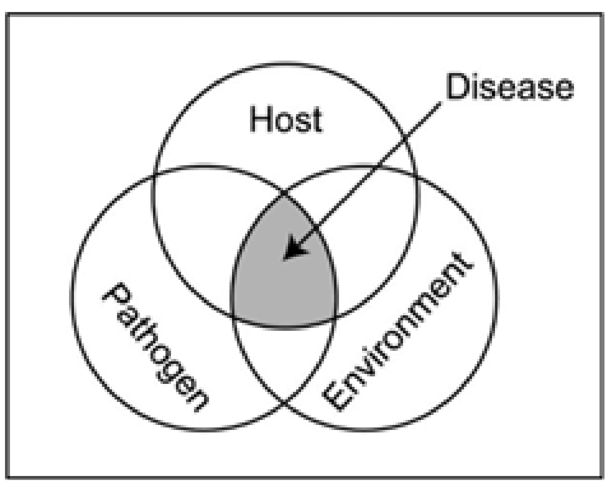



Fig.2.1 Relationship existing among the environment, fish and pathogen in an aquaculture facility

### 2.2.1 Common fish diseases

The majority of the fish diseases are caused by bacteria, viruses, fungi and parasites (Infectious diseases) while some are due to non-infectious diseases such as genetic, nutritional, water quality and others due to husbandly such as feed, handling and stocking densities amongst others.

- Fungal infections
- Bacterial diseases
- Viral diseases
- Parasitic infections
- Nutritional diseases

## 2.3 Types of diseases

There are two broad categories of diseases that affect fish and these are infectious and non-infectious diseases.

- Infectious diseases are caused by pathogenic organisms present in the environment or carried by other fish. They are contagious diseases, and some type of treatment to control the disease outbreak.
- In contrast, non-infectious diseases are caused by environmental problems, nutritional deficiencies, or genetic anomalies; they are not contagious and usually cannot be cured by medications.

### 2.3.1 Infectious Diseases

Infectious diseases are broadly categorized as viral, bacterial, fungal or parasitic. Infectious diseases can be termed as;

- acute (with peaks) or
- chronic (with long-lasting effects);
- simple (only diseases-producing organism is present) or
- multiple (more than one organism involved, for instance fungi and bacteria)

#### i. Viral Diseases

Viruses are the smallest form of life and pose a challenge to distinguish them from bacterial diseases. The most important feature of viruses is that they only reproduce inside a living cell. They can only survive within the body of a fish and once outside, remain inert (seemingly lifeless). And for them however to reproduce, they can only multiply by growth within host cells and cause damage to the host fish by destroying the cells they infest upon. Viruses can be passed from one cell to another by contamination. Infected fish can excrete some of the virus with urine, feaces and other secretions. This further makes the pond water to be infected and thus making more fish in that pond to be prone to the disease. Birds and crustacean parasites can be transmitters of viral diseases.

#### ii. Bacteria

Bacteria are unicellular or (more rarely) multicellular organisms that are responsible for many fish diseases. These are mainly those that are associated with environmental stresses such as handling. Bacteria are always present in water and they may also occur (in small numbers) on the skins of or within a healthy fish.

Bacterial diseases are often internal and require treatment with medicated feeds containing antibiotics which are approved by the Food and Poisons Board. Typically fish infected with a bacterial disease will have hemorrhagic spots or ulcers along the body wall and around the eyes and the mouth. They may also have an enlarged, fluid filled abdomen, and protruding eyes. Bacterial diseases can also be external, resulting in erosion of skin and ulceration. Rough handling of fish can also bring about bacterial diseases on fish.

#### iii. Fungal diseases

Fungi are parasitic or saprophitic organisms, living in water and on the skin of fish. When fish are infected with an external parasite, bacterial infection, or injured by handling, the fungi takes advantage and colonized damaged tissue on the exterior of the fish. Fungal infections are characterized by a greyish white woolly growth on the skin or eggs and may appear brown matted when removed from the water. Rough handling, high manure loading or extreme temperatures makes fungi to take advantage on fish. Such conditions will cause large ulcers and consequent loss of osmotic control. Formalin or potassium permanganate is effective against most fungal infections. Since fungal are usually a secondary problem, it is important to diagnose the original problem and correct it as well.

### 2.3.2 Non-infectious diseases

These can be broadly categorized as environmental, nutritional and or genetic as highlighted as follows

#### i. Environmental factors

The pond environment is subject to physical, chemical and biological factors which can adversely affect the health of fish and cause mortalities (See also on Module Water Quality). Environmental diseases include oxygen depletion, high ammonia, high nitrite or natural or man-made toxins in the aquatic environment. Water quality issues that need careful consideration include:

- **Oxygen depletion**
  Oxygen shortage is most likely to occur in heavily fertilized ponds, densely stocked and over fed ponds, cages, or tanks during a prolonged period of hot, calm weather. Large quantities of organic matter create a high Biochemical Oxygen Demand (B.O.D).
  This reduces the amount of oxygen available to fish and stimulates anaerobic conditions. The most critical time for oxygen depletion is at night when Photosynthesis has stopped and just before dawn when fish may be gasping for atmospheric air at the surface. Aerators and splashing of water in ponds must not bring about turbidity.

Effects of long-term low oxygen levels
- Fish is put under stress
- Fish appetite is reduced
- Fish are vulnerable to diseases

Solution amongst less intensive fish farms
- Reduce organic inputs
- Reduce stocking levels
- Increase water flow-through

- **Temperature**
  Fish have upper and lower thermal tolerance limits and optimum temperatures for growth, egg incubation, food conversion and resistance to specific diseases.
  Water temperature affects properties of the aquatic environment important for fish growth. In general, extreme temperatures make fish more susceptible to diseases. However, they can also kill fish directly. Rapid fluctuations in temperature can also be lethal. Shallow ponds and tanks should be discouraged as there is rapid increase or decrease of temperatures

- **Overstocking**
  The problems of fish diseases are related to stocking density, level of aquaculture technology applied and inputs going into the fish ponds. High fish stocking densities promote the spreading of diseases. Ammonia $NH_3$ and other pollutant levels will increase causing gill damage and promoting the spread Wof fungi.

- **pH**
  The optimum range for most freshwater species is from pH6 to pH9. Highly alkaline water (pH9+) will cause gill damage to the fish and occasionally damage the lens and cornea of the eye. In highly acidic waters (below pH5) pond productivity is significantly decreased and pH becomes directly harmful to fish. The main pathological reactions to low pH water are seen in the gills, although there are increases in the amount of mucus produced from the skin, and in the long-term, increase in the number of mucous cells in the skin epidermis. Other effects of low pH are gill damage, reduced tolerance to stress and hence resistance to disease, poor growth and poor food conversion.

- **Pollution**
  Polluted water is a major threat to some fish farms and can cause mass mortality if it is allowed to enter the ponds or tanks. The source of pollutants can be internal (that is produced with the pond or tank environment), but more likely external (such as industrial, domestic and agricultural effluents)

The following substances are known to kill fish if they are present in sufficient concentrations:

- Nitrites
- Ammonia
- CN compounds
- Chlorine
- Certain pesticides
- Heavy metals
- Very high levels of suspended solids
- Phenols and soap detergents

The toxicity of these substances depends on the species, size, and age of the fish and on the temperature and quality (for example, dissolved oxygen levels and hardness) of the water. Ground and spring waters are of considerable value for aquaculture because of two major properties: constancy of temperature and the virtual absence of parasites or microbial flora though they are not saturated with oxygen.

### ii. Nutritional factors

Nutritional diseases of fish may develop as a result if deficiency (malnutrition), excess (over nutrition), or nutrition imbalance (malnutrition) of nutrients present in their feed. Therefore excessive feeding or nutritional deficiencies may bring about diseases which are called nutritional diseases. A nutritional disease usually develops gradually because fish have body reserves that make up for nutritional deficiency up to a certain extent. One classic example of a nutritional disease of catfish is "broken back disease", caused by vitamin C deficiency. Brood fish, fry and fingerlings, need an optimum diet containing a high level of protein. Any deficiencies will result in reduced yields of fertile eggs, poor fry with a small yolk sac and lower survival rate. Stunted fingerlings are also a result of nutritional deficiencies apart from using poor parents for breeding.

### iii. Genetic abnormalities

These abnormalities include conformational oddities such as lack of tail or presence of an extra tail. Most of these are of minimal significance; however, it is important to bring in unrelated fish for use as Broodstock every few years to minimize inbreeding. In Malawi, National Aquaculture Centre and Mzuzu Fisheries is responsible to supply quality broodstock and monitor its effectiveness in ponds.

## 2.3.3 Parasitic Diseases

Parasites are organisms which spend part of their lives living on or in the body of another organism (animal), the host, at the expense of the latter. In fish, parasites may be found in all tissues but they are particular common on the skin and gills. Parasitic diseases of fish are most frequently caused by small microscopic organisms called protozoa which live in the aquatic environment. There are several species of protozoans which infest the mouth, gills and skin causing irritation, weight loss, and eventually death. Parasitic crustaceans e.g. Lernaea cause serious losses in Coptodon rendalli cultured in ponds. It inhabits the mouth and penetrates the tissues of the palate. As many as 9 parasites can be found in one fish which hinder feeding of the fish.

Fish may either be the final or intermediate hosts in the lifecycle of the parasite. Where fish are the final hosts, frogs, tadpoles and snails often act as intermediate hosts. Fish-eating birds are often the final hosts for disease producing parasites. In normal circumstances, a healthy fish and its parasites maintain an even balance, but when a fish is stressed by overcrowding, mishandling, or by water or nutritional problems, the parasite burden can build up very quickly, therefore casing heavy losses. Control of most protozoan infections is relatively easy by using standard fishery chemicals such as copper sulfate, formalin, or potassium permanganate.

- Life cycle of fish parasites

The life cycles of the various fish parasites show an enormous diversity. Often the cycle involves the use of one or more intermediate hosts and in such intermediate hosts parasites are present as larval or juvenile forms. Complex life cycles of this nature are often necessary to ensure the dissemination of infective stages to the final host in which maturity will occur. Fish may also be utilized as intermediate hosts by parasites. Intermediate hosts often form part of the diet of the final host or the next intermediate host in the life cycle, which ensures the parasite's progress to its next stage. In other cases, free - living stages may be released from the intermediate host to actively invade, or be eaten by, a further host. Many fish parasites spend at least some part of their life cycle outside a host. Those parasite species with a direct life cycle infect other hosts by means of free - swimming larvae, which often actively invade the host, or by means of spores, or eggs which are ingested. Knowledge of the life cycles of fish parasites, in all their complexity, is essential if successful preventive measures are to be achieved, as it allows the parasite to be attacked at the most vulnerable point of its life cycle.

### 2.4 Identification, causes, control, prevention of fish diseases in aquaculture

Diseases are heralded by appearance of structural or behavioral abnormalities. It is necessary to know what is normal for any species of fish we deal with. We need to know the significance of each structural component of the fish in relation to its health. A fish farmer is also a researcher at the farm or in a hatchery and should be able to recognize an abnormality in a fish and identifying a possible cause. As a farmer or hatchery operator you should therefore seek to have the experience and knowledge to distinguish between what is a normal and abnormal fish behavior such as changes in swimming pattern, loss of appetite, or reaction to stimulus.

What could you do if you find that your fish is swimming at an angle of 900 facing upwards or it swimming in any unusual way? Think about what you could do if you could see that your fish are not coming out to eat or they are approaching the feed but can't eat?

In general, when a problem has been identified on a farm it is necessary to find out the following

- What it is the problem?
- When did it start?
- What is the quality of water?
- Are there any changes to water quality?
- How good is the feed we last fed the fish?
- What has been done so far?
- Has any treatment started already?
- What were the results?
- Is it possible to clinically examine a fish sample?

### 2.4.1 Infectious Fish Diseases

| Disease | Causes and signs | Preventive/Corrective Measure |
|---|---|---|
| Fish scurvy | · Deficiency of Ascorbic acid<br>· Spinal deformity at post larvae stage<br>· Anorexia, erosion of fins and opercula, shot snout, hermorrhages in eye and fins, abnormal skull, swollen abdomen, poor growth. | High doses of vitamin C intake can provide increased resistance against several pathogenic bacterial and virus species in fish |
| Broken back syndrome | · Common in catfish in super- intensive culture<br>· Arises with feeding fish with Vitamic C deficient diets for more than eight weeks<br>· Leads to biochemical dysfunctions and consequent organ dysfunction | Check vitamin C levels in any feed procured or made |
| Lipidosis | · Feeding of rancid formulated feeds and fatty or poorly stored feed<br>· Fish in grow out stage are more susceptible<br>· Fish shows poor growth but low mortality rate, lethargic movement, opaque eyes, slight distension of abdomen and pale appearance of liver | Always check the quality of feed before you feed your fish. Rancid feed must not be given to fish. |
| Obesity | · Fatty infiltration of the liver<br>· Deficiency of biotin or choline in feed | Feeding fish with right the feed requirements levels |
| Carbohydrates deficiencies | · growth retardation due to gluconeogenesis<br>· Sekoke disease is one of the common Carbohydrate related diseases | Elimination of excess amount of starch from diets can prevent this disease |

### 2.4.3 Nutritional Deficiency Symptoms

| Nutritional Deficiency | Effects in Fish |
|---|---|
| Protein Deficiency | · Leads to growth suppression, skeletal deformities, appetite depression<br>· Can lead to poor utilization of dietary protein and may result in growth retardation, less weight gain and low feed efficiency<br>· Amino acid deficiency can lower the resistance of fish and the effectiveness of the immune system in severe cases |
| Lipids deficiency (Maintains the structure and function of cellular membranes) | · Poor food efficiency, susceptibility to caudal fin erosion swollen pale fatty liver, shock syndrome, decreased haemoglobin and blood cell volume<br>· In Broodstock lead to reduced egg quality, poor hatchability and reduced larval survival |
| Carbohydrates deficiencies (Source of energy) | · growth retardation due to gluconeogenesis<br>· Sekoke disease is one of the common Carbohydrate related diseases |
| Vitamin Deficiencies | · Nutritional deficiency are difficult to detect as signs develops slowly<br>· Poor appetite, poor feed efficiency and reduced weight are some signs |
| Mineral deficiency | · In fish, the provide important roles in osmoregulation, scale and Skelton formation and intermediary metabolism<br>· Deficiency appears due to dietary imbalances and interaction of dietary components. |

- Guide to Nutritional Diseases and preventive measures

| Symptoms | Cause | Prevention |
|---|---|---|
| - Caudal fin erosion<br>- Loss of appetite | Lack of protein | Feed protein rich feed like soya beans, slaughter house by-products, fish meal |
| Poor growth | Lack of lipids | Feed with energy-rich feeds |
| Poor growth | Lack of vitamins | Feed with fortified feed |
| Poor growth | Lack of minerals | Feed with fortified feed |

## 2.5 General Principles of treatment

### 2.5.1 Whenever an infectious disease has been diagnosed;

- Examine the husbandry practices to try to learn the factor(s) that are contributing to the disease. The first thing to do is to make adjustments on the husbandry practice or improvement in water quality will help in checking the disease.
- Whenever the disease has reached an advanced stage or changing pond conditions is difficult, treatment is the best solution.
- In most cases, treatment is costly in terms of labor as it will require skilled labor and also chemicals. Treatment has therefore to be carefully considered if worth the expense which depend largely on the value of fish. For example, one cannot treat a disease on fish which will cost almost the same or higher the value of the fish.
- The alternatives to the treatment are to let the fish run its course and accept possibility of high mortality rate or harvest the fish rapidly and cut losses.

### 2.5.2 Before carrying out a course of treatment, consider the following

- Most chemicals used in treating fish are toxic to the fish and humans as well as to pathogens and their tolerance level varies with species and environmental conditions.
- The nature of the disease and type of drug or chemical to be used.
- Water hardness and pH should be measured
- Oxygen levels must be measured
- Fish should be starved for 24 hours. This lowers toxic waste products, oxygen demand and in some cases suspended solids in the water
- Size of fish to be treated
- The type of holding facility (pond, tank, hapa)

- The choice of treatment method can be:

| **Method** | **Why the method?** | **How to do it? – The Process** |
|---|---|---|
| Immersion | · Used for external parasites and bacteria<br>· Targets the skins and the gills | 1. DIP<br>- Fish are immersed in a high concentration<br>- It should be for a short time<br>- Care must be taken to avoid stressing fish<br>2. BATH<br>- Similar to dip but exposure time is longer, concentration lower<br>- Useful for chemicals which breakdown slowly<br>- Good for ponds for slow flow-through to flush out chemicals slowly<br>3. FLUSH<br>- Good for a controllable or constant flow-through of water<br>- Chemical is easily diluted and properly mixed in the holding facility<br>4. FLOWING<br>- Constant volume of a chemical is added at the inlet for a fixed period<br>- Volume must be constant to give the required concentration which is diluted ad spreads through the holding unit. So expensive |
| Systemic | · For treating systemic infections like bacterial<br>· Uses antibiotics and some internal helminthics | - Drug is added into a fish feed<br>- As sick-fish lose appetite, challenge is that fish might not eat the food<br>- Fish can reject the drug treated feed as it becomes distasteful<br>- Use of strong smelling food re flavour enhancers is recommended |
| Injection | · Mainly to administer antibiotics | - Normally injections used on brood stock<br>- Injections may be intramuscular, using a site between the dorsal fin and the lateral line, or intraperitoneal, or at the point between anal fins and the pelvic fins on the ventral surface<br>- It is labour intensive and stressful to fish |
| Swabbing | · On open fish wounds or ulcers | - Carefully calculating required chemical quantity, accuracy must be checked by another person<br>- Check fish for any stressful signs during treatment<br>- Aeration should be used to mix the chemical more quickly and to boost dissolved oxygen in the water<br>- Treatment results be checked by examination of several sampled fish after completing treatment<br>- Depending of life history of pathogen, repeat treatments can be done. Caution: ensure not to damage gills of fish and accumulated toxicity<br>- Fish intended for human consumption must not be marketed for 3 - 4 weeks following the treatment. |

It should be noted that for many diseases there are no chemical or drug therapies available and only changes in management practices will eliminate or control the disease.

### 2.5.3 Monitoring Fish Health Status

Knowledge on normal condition of fish is necessary for recognition of abnormalities. Deviations from normal are difficult if you do not know baseline information. The baseline can be obtained from periodic monitoring and observation of the fish you are dealing with. It is important to get accurate and detailed baseline information. These help in detecting early signs of ill health in the fish.

As the Manager of a fish farm you should ask yourself the following points in order to make a clear diagnosis of the situation

- Were there any recent mortality? If so, what species were involved and how many? What were their sizes and ages? If it is a well-run farm you should be able to estimate the age. Scales and otoliths may help in age determination.
- Have any dead fish been preserved for further diagnosis? Preservation by freezing and/or appropriate fixation may be required.
- Have the fish been behaving normally? Note unusual behaviour (movements, distribution, scraping against the bottom or submerged objects, rapid respiratory movements)
- How do the fish feed, especially during the first feeding of the day? How do they react to the appearance of man? Do they feed eagerly, or are they sluggish and refuse to feed?
- What is the diet? Has it been changed recently?
- Do the fish how any unusual appearance (abnormal colouration, frayed or eroded fins or opercula)?
- Has there been a change in the usual routine recently? Have the fish been given chemical treatment?

Samples should be examined for the presence of parasites and microorganisms. The fish's general condition should be recorded. Be prepared to establish your own 'library' of normal tissue conditions taken from various organs of all species you deal with and from many localities as possible.

Note: It is necessary to report any suspicious observations you have made even on a single fish. It leads to prevention. Isolate the fish from other fish to prevent further spreading of the disease

In case of something suspicious on the external or internal of the fish, what should we observe?

| **Things to observe** | **Questions to ask** |
|---|---|
| Water Quality | · Is the color and smell of the water normal?<br>· Is there is sudden algal bloom?<br>· Is the system overstocked?<br>· Have I checked on oxygen and temperature? |
| Feed | · Is feed being eaten?<br>· How long does all feed take to be eaten?<br>· Is it the right feed?<br>· What's the quality of the feed?<br>· Is it fresh enough for the fish?<br>· Is the fish growing properly with the feed? |
| Fish behavior | · Is it smoothly swimming and unstressed?<br>· Is it quickly reacting to external stimuli?<br>· Is it eating properly?<br>· Is it tumbling, apparently lying on the bottom?<br>· Is it surfacing with an open mouth? R<br>· Are fish in the breeding season?<br>· Are they cannibalistic? |
| The Fish externally | · Is the fish adapting its complexion to that of the environment?<br>· Is the skin slimy and glossy without damage?<br>· Are there predator bruises on the fish?<br>· Are there seen lesions or big parasites on the body?<br>· Is the tail fin not rotten?<br>· Are there blisters on the fish? |
| The Fish internally | · Do the organs have the normal colour?<br>· Are the not swollen or pale?<br>· Are there no haemorrhages or abnormal ascetic fluid?<br>· Are there haemorrhages in the organs?<br>· Are organs not swollen?<br>· Are there parasites inside the fish? |
| On the pond area | · Are there no weeds around the pond?<br>· Is there an indication presence of predators?<br>· What's the average population of predatory birds at the farm? |

**Two methods of defenses are**

| 1. Protection | 2. Prevention |
|---|---|
| · Provision of pathogen free water<br>· Provision of pathogen free food<br>· Hygiene<br>a. Disinfection of habitat<br>b. Disinfection of equipment<br>c. Disinfection of fish<br>· Control of wild fish<br>· Vector and pest control<br>· Transport regulations<br>· Quarantine<br>· Regular prophylactic survey<br>· Independent water supply<br>· Age segregation | · It's a must to build up the strength of the fish to resist the pathogens<br>· Provide fish with everything it needs, particularly<br>a. Satisfactory environment and ample and qualitatively complete food<br>b. Avoiding stress through<br>- Water<br>- Food<br>- Population density<br>- Immunization<br>- Genetic manipulation<br>- Handling |

### 2.5.4 Some Commonly Used Drugs and their use

| Drug | Used on | How to use it |
|---|---|---|
| Salt NaCl | · Saprolegnia<br>· External protozoan, leeches, crustaceans | · Dilute table salt in water<br>· Indefinite bath 1000ppm<br>· 20 – 30 minutes bath 3000ppm<br>Note: useful for severely stressed fish and where gill damage is severe |
| Copper sulfate (CuSO) | · External protozoan | · Indefinite bath 0.2 -2 ppm 1000 ppm according to the hardness of the water<br>· If carbonate is less than 50 ppm, use dosage less than 1 ppm<br>Note: very toxic to fish. When using hard water, add acetic acid to the same concentration. More toxic to soft water |
| Magnesium sulphate | · Some intestinal sulphate | · Mix in food<br>· 3% of ration |
| Kerosin, Diesel fuel, motor oil, vegetable oil | · On air breathing beetle<br>· Notonectids | · Spread it on the surface<br>· It floats on the surface<br>· Put 20 – 40 litres/ha |

| | | |
|---|---|---|
| Formalin | · External parasites in gills and on skin<br>· Efficient for protozoan | · 40% aqueous solution of formaldehyde<br>· Indefinite bath 20 ppm<br>· 30 minutes bath 200ppm. If necessary repeat for 3 days<br>· It deoxygenates water, toxicity increase with soft water<br>Note: Never use bacterial gill diseases. Avoid fumes, they are toxic. 40% solution formaldehyde = 100% formalin. Add 1 grain malachite green to colour the solution. If there are white crystals on the bottle, solution is toxic, must be discarded. Causes successive liver damage |
| Formalin/Malachite green mixture | · Stubborn external parasites on gill/skin e.g Ichthyopthirius | · Stock solution – 3.68gr zinc free per 1 litre formalin<br>· 6 hour bath 25 ppm stock solution<br>Note: Less harsh on fish than pure formalin |
| Malachite green | · Anti-fungal agent for eggs/fish "Ich", external protozoan | · Crystals – stock solution 1 000 ppm. Solution – 50% W/v often available<br>· Eggs 60 min bath 2 ppm<br>· Fish 60 min bath 2 ppm<br>· 30 min flush 5 ppm, 30 sec dip 50 ppm<br>Note: Avoid contact with skin. Highly |
| Trichlorphon (Dipterex) | · External parasites like flukes, adult Argulus | · Liquid powder (80% trichlorphon)<br>· 60 min bath 4 – 10 ppm in a static pond<br>**Note:** Persists for weeks in acidic water. Degrades quickly in alkaline water. Avoid skin contact. Will kill most invertebrate food sources |

### 2.6 Significance of fish disease in aquaculture

Fish diseases continue to be one of the greatest causes of substantial economic impact on the aquaculture industry. In fish farms and hatcheries, production costs are easily increased by disease outbreaks. The economic impacts caused by parasites and diseases are both direct and indirect; due to clinical disease and mortality, the costs of preventive and control measures, surveillance regimes, diagnostic investigations and the destruction of infected but healthy stocks due to legal requirements. This is as a result of investment losses due to fish mortalities, cost of treatment, and decreased fish growth due to convalescence. Fish farmers and hatchery operators will need to spend extra incomes to replenish their facilities with new stock of fish. With the current outbreak of EUS in some districts of Malawi, the disease has presented as an economic marketing problem. Fish farmers in areas where cases of EUS were reported had challenges to sell their fish as consumers had reservations in buying fish from such areas.

### 2.7 General prevention and control of fish diseases

#### 2.7.1 Pond or Tank Layout

Poorly designed and laid out ponds or tanks can be a source for the spread of diseases. Therefore ponds and tanks must be designed, laid out and constructed in a manner in which the orientation will best suit the facilities in order to prevent the occurrence of fish diseases.

- Ponds and tanks must be designed in such a way that there are no incidences of polluted water entering them.
- Water from one fish farm or pond/tank should not drain into other farms/ponds/tanks.
- Each pond or tank must have an independent inlet and outlet and drain into the sedimentation pond before discharged to the environment.
- Put sedimentation pits and screens in canals taking water to ponds and tanks. This prevents the entry of eggs, unwanted fish and organisms into ponds and or tanks

#### 2.7.2 Source of fish

Only take fish from reliable sources. Fish quality must be certified and be free from parasites and diseases. Fish must be free from any fungal, viral or bacterial infections. Any suspicious fish must not be brought to our farms. Prevention is better than cure. Fish from other sources must be bathed in a salt solution before they are stocked.

#### 2.7.3 Proper management

Proper management leads to good fish health and disease prevention. Improper management will usually lead to disease outbreaks. Disease outbreaks due to poor management may affect the quantity, quality and prices of fish in the market.

A farmer must know that poor performance of fish farms may be caused by a number of factors which include:

- Poor water quality
- Less water quantity,
- Shallow ponds on tanks which will be prone to extreme or changeable temperatures
- The quality and quantity of feed used
- Bad management practices
- Poor fertilisation
- Poor predation control mechanisms.

#### 2.7.4 Water quality management

Poor water quality parameters such as PH, temperature, dissolved oxygen; turbidity may lead presence of pathogens and disease outbreaks.

#### 2.7.5 Proper feeding

Increased nutrient levels due to intensive culture promote proliferation of parasites. Pollution due to high levels of ammonia predisposes fish to succumb to large numbers of parasites. Right quantities and size of feed should be given to fish at all times. This helps to minimize feed losses which sink at the bottom of the pond and pollute water.

#### 2.7.6 Proper fish sampling - Do not sample when:

- Fish are sick and show signs of extreme stress
- When there is lightning during a rain-storm.

- If it has just rained and there has been a lot of muddy water run-off especially in ponds.
- When the water quality is poor (e.g. fish gasping for air;
- Very high and low water temperatures;
- Low dissolved oxygen levels).

## Summary

Fish diseases are recognized as some of the biggest challenges for the sustainable development of aquaculture in the country. If a fish farmer is to make good profits, diseases must be carefully prevented at all costs. Diseases can make a farmer lose an entire production at the farm. Fish health is influenced by three factors; the environment, stress and pathogens (diseases) and the majority of the fish diseases are caused by bacteria, viruses, fungi and parasites (Infectious diseases) while some are due to non-infectious diseases such as genetic, nutritional, water quality and others due to husbandly such as feed, handling and stocking densities amongst others. As all surface waters may contain species of wild fish which can act as reservoirs of infectious disease, screens must be put to prevent entry of eggs and unwanted fish into our culture facilities. Animals other than fish may be reservoirs of infection as well as intermediates in the life cycles of many parasites. Good management practices towards maintaining good fish health must be followed at all times. Necessary drugs with consultations with technical officers can be used

Management of the pond, tank or cage environment is probably the most important factor for disease prevention in aquaculture. As intensive aquaculture systems are reliant on nutrient- rich feed inputs, if not properly managed, they can cause deterioration of the pond, tank or cage environment leading to diseases. Poor manure application and use of untreated manure can bring about diseases to fish.

The impact from disease may occur as direct losses due to mortalities as well as indirect effects such as decreased production (reduced growth rates, feed convention efficiency, product quality), and loss of business or reputation. At all times, good husbandry, low stocking density, and possibly high protein or mineral feeds must be adhered to.

## 2.8 Epizootic Ulcerative Syndrome (EUS)

### Introduction

Epizootic Ulcerative Syndrome (EUS) is a seasonal epizootic condition of great importance in wild and farmed freshwater and estuarine fish. It has a complex infectious aetiology and is clinically characterised by the presence of invasive Aphanomyces infection and necrotising ulcerative lesions, typically leading to a granulomatous response. EUS is also known as red spot disease (RSD), mycotic granulomatosis (MG) and ulcerative mycosis (UM). The oomycete that causes EUS is known as Aphanomyces invadans or A. piscicida. Parasites and rhabdoviruses have also been associated with particular outbreaks, and secondary Gram-negative bacteria invariably infect EUS lesions. The genera Aphanomyces is a member of a group of organisms commonly known as the water moulds. Although long regarded as a fungus because of its characteristic filamentous growth, this group, the Oomycetida, is not a member of the Eumycota, but is classified with diatoms and brown algae in a group called the Stramenopiles or Chromista. The disease is particularly prevalent at colder temperatures (18 to 22 °C) during the winter and rainy seasons

### Aim

The aim of this session on Epizootic Ulcerative Syndrome (EUS) is to provide participants and users of this module with background information on this important disease, improve their knowledge and as well as practical recommendations for its diagnosis and control.

### Objectives

- Participants know
- What EUS
- Impacts on aquaculture and fisheries
- Biosecurity measures to prevent EUS

Acquired skills
- Basic ways of preventing and controlling EUS
- Identification of signs and symptoms of the disease

- Acquired attitudes
- Control and prevention of EUS requires careful planning and following good aquaculture practices.

- Relevance to fish production
- Good quality fish from farms will be highly accepted if they will be free from EUS infections leading to higher profits

- Session Overview:
- Materials: Flip- chart paper, markers, study notes, posters– images of infected & uninfected fish.

- Mode of delivery: Lectures, group discussions and practical
- Duration : 60 minutes

### 2.8.1 What is EUS?

Epizootic ulcerative syndrome or EUS is an infection caused by oomycete fungi known as Aphanomyces invadans or A. piscicida. Aphanomyces is a member of a group of organisms formerly commonly known as water moulds; they are currently recognized as belonging to the group of heterokonts or stramenopiles. The disease is an epizootic condition affecting wild and farmed freshwater and estuarine fish since it was first reported in 1971. EUS is also known by other names such as red spot disease (RSD), mycotic granulomatosis (MG), ulcerative mycosis (UM) and in 2005 it was suggested to rename EUS as epizootic granulomatous aphanomycosis (EGA).

#### Life cycle

Aphanomyces invadans (Saprolegniales, Oomycetes) has an aseptate fungal-liked mycelia structure. This oomycete has two typical zoospore forms. The primary zoospore consists of round cells that develop inside the sporangium. The primary zoospore is released to the tip of the sporangium where it forms a spore cluster. It quickly transforms into the secondary zoospore, which is reniform with laterally biflagellate cells and can swim freely in the water. The secondary zoospore remains motile for a period that depends on the environmental conditions and presence of the fish host or substratum. Typically, the zoospore encysts and germinates to produce new hyphae, although further tertiary generations of zoospores may be released from cysts (polyplanetism).

### 2.8.2 Disease pattern

- **Transmission mechanisms**

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. If the zoospores cannot find the susceptible species or encounter unfavorable conditions, they can form secondary zoospores. The secondary zoospores can encyst in the water or pond environment waiting for conditions that favour the activation of the spores. How the Aphanomyces pathogen or its spores survive after the outbreak is still unclear as outbreaks usually occur about the same time every year in endemic areas.

- **Temperature**

Both low and high temperatures appear to influence outbreak occurrence and it is likely that these influences at least partially explain the seasonally recurrent pattern of EUS outbreaks. Low temperatures appear to influence the severity of EUS lesions, and hence the severity of an outbreak, by impairing the ability of individual fish to contain and inactivate the invasive fungus.

- **Prevalence**

The prevalence of EUS in the wild and in aquaculture farms is high in endemic areas that share the same water way or system. Uncontrolled water exchange in fish farms in endemic areas will result in EUS outbreaks in most of the farms that culture susceptible fish species.

- **Geographical distribution in Malawi**

In Malawi EUS was first reported at Dambo village, Mlonyeni Extension Planning Area (EPA) in Mchinji District within Kasungu ADD. The disease later spread to other water bodies like in Bua River within Mchinji. Other reported cases later emerged in fish farmers' ponds in Dowa, Chia Lagoon in Nkhotakota and a water reservoir in Chinyolo area in Rumphi.

### 2.8.3 Susceptible host species

EUS has been observed to cause disease and mortality in farmed and wild fish in Malawi. Some of the fish species to have been infected and affected include Oreochormis shiranus, Oreochromis karongae, Coptodon rendalli, Clarias gariepinus (catfish)

- **Clinical signs of infected fish**

Fish infected with EUS may have one or more signs including:

- Small pinpoint red spots
- Swelling areas
- Protruding or missing scales

- Skin sores or ulcers
- Red areas of the skin most especially under the scales
- The behavior of infected fish is characterized by a reduction in appetite.
- Fish become lethargic and float slightly beneath the surface or with the head out of the water and small red spots develop over the body.
- As the name of the disease suggests, the main clinical finding is generally the presence of dark-red circular or oval spots (2–4 cm) on the skin, with ulceration extending up to 0.5cm down to the muscles
- Small erythematous foci are seen as early lesions on the skin and may develop into a necrotizing dermatitis and result in a deep dermal ulcer in the chronic stage
- Loss of scales and development of haemorrhages can be observed in early affected fish, while in more advanced stages the lesions can be so complete that the internal organs become apparent through the lesion. Most fish species die at this stage

- **Diagnosis of EUS**

Ulcerative skin lesions are common in freshwater and estuarine fishes. The presence of lesions often indicate contaminated or stressed aquatic environments and may be associated with a variety of infections including parasites, bacteria, viruses and fungi, as well as non-infectious causes such as for example toxic algae.

- Presumptive diagnosis: of EUS can be based on gross appearance (open dermal ulcers) (Bondad-Reantaso et al., 2001) and the observation of aseptate hyphae in squashed preparations of the muscle underlying gross lesions.

- Confirmatory diagnosis: requires histological demonstration of the typical granulomatous inflammation around invasive hyphae or the isolation of Aphanomyces invadans from the underlying muscle.

## 2.9 EUS preventative measures

To protect your fish from EUS take the following measures:

- Remove any infected fish from the pond and dispose it by burning or burying in order to avoid transmitting the disease to other ponds and or rivers and lakes
- Use separate equipment between ponds and do not borrow or lend equipment between farms.
- Sample your fish on a frequent basis to check for infected fish
- Disinfect equipment i.e. harvesting net, when moving between different ponds where possible.
- Avoid bringing water into your ponds from external sources e.g. lakes, rivers, streams etc.
- Ask your fisheries officers to help you on water pH measurement.
- Report to fisheries officers if you find any fish with lesions, wounds or any of the mentioned signs
- Prevent discharge of waste water into the local environment
- Do not sell, share or move any fish to any other aquaculture facility
- Do not send any infected fish to the market

- **Disinfection of eggs and larvae**

Routine disinfection of fish eggs and larvae against water molds is equally effective against A. invadans. It should be noted that there is no report of the presence of A. invadans in fish eggs or larvae. Control of EUS in natural waters is probably impossible. In outbreaks occurring in small, closed water bodies or fish ponds, liming water with agricultural limes and improving water quality, together with removal of infected fish, is often effective in reducing mortalities and controlling the disease. Ensuring no leakage of water from EUS-infected areas into fish ponds is a normal practice that easily prevents the spread of

EUS into farms.

- **Sampling: Selection of individual specimens**

Scoop net, cast net or seine net represent the best choices for catching EUS-infected fish in natural waters or in fish ponds. For outbreak investigations, diseased fish with ulcerative lesions or red spots on the body should be sampled.

- **Challenges associated with EUS**

- It causes high losses to fish farmers and fishermen through mortalities and public health concerns due to the presence of ugly lesions and reduced productivity of all susceptible fish species.
- Some losses are indirect socio-economic costs due to market rejection of harvested ulcerated fish, or in some cases, even unaffected fish.
- Of greater concern to farmers is the possibility of severe allergic reactions affecting farm workers in contact with the drug.
- There is also the danger that consumers may be exposed to drug residues in marketed fish that had been hurriedly harvested before the recommended withdrawal period had been completed.
- Other indirect long-term effects include the threat to the environment and aquatic biodiversity through, for example, declining fish biomass and cause irreversible ecological damage.
- EUS has the potential to financially decimate those who rely on fishing for income.
- More importantly, EUS outbreaks threaten food security for subsistence fishers and fish farmers and subsequently people's physical health, as fish are an important source of animal protein for people in the affected countries.

Fish exhibiting deep ulcerations and tissue decay, which could harbour secondary pathogens which may have human health implications, the fish infected with EUS do not pose human health hazards for consumers. The agent causing EUS does not pose any human health implications. However, it is recommended not to eat EUS fish unless it is properly and thoroughly cooked.

### 2.9.1 Biosecurity measures on EUS

A number of simple biosecurity measures can minimize or prevent the spread of EUS. These include:

- All possible carriers or vectors such as freshly dead fish, birds or terrestrial animals as well as contaminated fishing gears/net and fish transport containers should be prevented from getting into water bodies or fish ponds.
- In outbreaks occurring in small, closed water bodies, liming of water and improvement of water quality, together with removal of infected fish, are often effective in reducing mortality.
- Increasing salinity in holding waters may also prevent outbreaks of EUS in aquaculture ponds.
- During dry and cold seasons, close observation of wild fish should be made to determine the presence of EUS–diseased fish in neighbouring tanks or canals, in which case, exchange of water should be avoided.
- EUS infected fish should not be thrown back to the open waters and should be disposed of properly by burying them into the ground or through incineration.

- **Additional practical aquaculture biosecurity measures include:**

- Good farm hygiene (e.g. hand washing between tanks, separation of nets/ tanks/ stocks, regular and correct disinfection procedures, etc.)
- Good husbandry practices
- Good water quality management
- Proper handling of fish
- Regular monitoring of fish health
- Good record keeping (gross and environmental observations and stocking records including movement records of fish in and out of aquaculture facility amongst others.)

Summary

EUS is a relatively newly described fish disease and there is still a lack of effective strategies for its prevention and control. A diverse group of biotic and abiotic agents, including viruses, bacteria, cutaneous ectoparasites, low pH and low dissolved oxygen concentrations, may initiate skin lesions in freshwater and estuarine fish and that these non-specific lesions are subsequently colonised by A. invadans. Some EUS outbreaks are associated with heavy rainfall and flood events, drop in temperature, low alkalinity and salinity, acidified run-off water from acid sulphate soil areas. The risk of a EUS outbreak in an aquaculture operation may be mitigated by maintaining stable water quality and keeping the pH, temperature and alkalinity of the water within normal ranges. Physical injuries or trauma to the fish are thought to predispose fish to an outbreak of EUS.

EUS has been seen to be causing high losses to fish farmers and fishermen through mortalities and public health concerns due to the presence of ugly lesions and reduced productivity of all susceptible fish species. Some losses are indirect socio-economic costs due to market rejection of harvested ulcerated fish, or in some cases, even unaffected fish. There is also the danger that consumers may be exposed to drug residues in marketed fish that had been hurriedly harvested before the recommended withdrawal period had been completed. EUS has the potential to financially decimate those who rely on fishing for income. More importantly, EUS outbreaks threaten food security for subsistence fishers and fish farmers and subsequently people's physical health, as fish are an important source of animal protein for people in the affected countries.

Some biosecurity measures aimed at minimizing spread of EUS include prevention of all possible carriers or vectors such as freshly dead fish, birds or terrestrial animals as well as contaminated fishing gears/net and fish transport containers should not be allowed to get into our fish farms and water bodies. Good farm hygiene (e.g. hand washing between tanks, separation of nets/tanks/stocks, regular and correct disinfection procedures, etc.), good husbandry practices and good record keeping (gross and environmental observations and stocking records including movement records of fish in and out of aquaculture facility amongst others) should be followed.

# Biosecurity



Introduction

Biosecurity generally include a standardized set of practices, procedures and policies adopted and set to eliminate disease outbreaks from host and culture environments as well as limiting their spreading and establishment. Observing good biosecurity measures will minimize the fish's exposure and susceptibility to disease causing pathogens (like bacteria, viruses, fungi, parasites and other invasive species), reduces economic losses from mortalities and helps firms to continue having a good reputation in the sector. Furthermore, it enhances food safety, protects the investments by preventing economic losses optimizing the health and immunity of fish stocks. Disease outbreaks happen rapidly and spread quickly, often resulting in high mortalities. Disease threat can vary with the types of production, purpose and the species or life stage being reared.

Biosecurity measures are crucial for a successful farm or hatchery operation. This chapter provides a very basic understanding of how biosecurity can be carried out at a fish farm on a hatchery and what needs to be done to minimize the risk of an outbreak.

Aim

The aim of this chapter is to improve participants'' knowledge and understating on the basic principles biosecurity and improve their skills on how to minimize risk of disease outbreak in an aquaculture facility

Objectives

- Participants know
- What biosecurity is
- Importance of biosecurity and biosecurity measures
- Activities for effective biosecurity
- Cleaning and disinfection protocol

Acquired skills

- Basic ways of promoting biosecurity at a fish farm or in hatchery
- Measuring disinfectants and how to use them
- Identification of fish diseases;

- Acquired attitudes
- Control and prevention of fish parasites and diseases requires careful planning and following good aquaculture practices.

- Relevance to fish production
- Fish free from parasites and diseases respond well to feeds and grows better
- Expenditure on fish disease treatment can be avoided with biosecurity measures
- Fish products free from parasites and diseases are highly accepted on the market leading to higher profits

- Session Overview: This chapter has one session which is on Fish Health and Management
- Materials: Flip- chart paper, markers, study notes, posters– images of infected & uninfected fish.

- Mode of delivery: Lectures, group discussions and practical
- Duration : 60 minutes

### 3.1 Biosecurity

Biosecurity is the establishment and implementation of a system or procedures to prevent the introduction of pathogens into a fish culture facility or hatchery from outside the facility or into a section of the hatchery from another section in the same hatchery. Biosecurity is a common-sense method of prevention to avoid contact between animals and pathogens. It does not have to cost too much money, and it is good practice to use in any farm. If biosecurity measures are not followed, more time is used and more money is spent trying to cure a disease when it does appear. For fish hatcheries, biosecurity consists of various, simple, sometimes zero-cost measures that will keep pathogens away from fish and keep fish away from pathogens. Pathogens (bacteria, parasites, fungi, viruses) are infectious agents that can cause disease. The principles of biosecurity can be applied in both large-scale fish farms and even in backyard or small-scale fish farms.

#### 3.1.1 Biosecurity, its need

Fish farmers and hatchery operators invest a substantial amount of money to establish either a fish farm or a hatchery to produce table sized fish or fry/fingerlings, and they expect to generate income from their investment. As such, caution must be taken from the beginning to ensure the facility is properly designed so that routine operations can run smoothly. The expectations are that table sized fish produced are of good quality. It is fry or fingerlings produced from a hatchery for distribution to farmers must be of high quality and have good survival rates. In any live animal production facility, there is always the risk of introducing pathogens that can cause disease. Diseases can come from many sources, such as new broodstock, contaminated equipment, birds and other animals. They can even find their way into a hatchery during routine operational activities. A disease outbreak can cause severe financial losses and be a serious setback for a fish farmer or a hatchery operator. Because of this, biosecurity measures are needed to minimize the risk of financial loss. Even though biosecurity prevents the introduction of pathogenic agents by using prophylactic measures to avoid a crisis, hatchery operators often give it low priority. Instead, they usually take the crisis management approach whereby action is taken only when fish start dying in large numbers.

#### 3.1.2 Benefits of biosecurity

Bio-security is the cheapest and most effective way of controlling diseases. A bio-security stand on the principle of prevention is better than cure. The goal of the bio-security programme is three-fold:

- Minimize introduction of new diseases
- Limit the spread of diseases already on the farm
- Reduce the risk of diseases being carried across farms

Biosecurity allows hatchery owners to minimize the risk of the following:

- The occurrence of a disease outbreak
- High fish mortality
- High financial losses from the loss of fish
- A setback caused by the disruption of production
- High operation costs to clean up the premises after an outbreak
- Project failure
- Loss of clients, who will no longer trust the quality of our fish products, fry/fingerlings.

After an outbreak, even doing a thorough cleanup of the hatchery will not guarantee that the fry/fingerlings produced are free of the disease. Implementing biosecurity is about adopting good management practices, which cost less than treating diseases. Implementing biosecurity assures a successful project.

#### 3.1.3 Biosecurity measures

On a daily basis, it is necessary to pay attention to the risk factors likely to occur in the various phases of rearing, as follows:

i. The quality of inputs: Whether they are animals (eggs, larvae, juveniles...) or supplies (food, veterinary products), it is essential to check the quality of all resources that are used in the farm.

ii. The quality of incoming water: This is a more or less controllable variable depending on the rearing system that is applied. After all aspects of the pre-installation phase have been checked, the water must then be sampled periodically. This is a key parameter that needs to be monitored and assessed on an on-going basis.

iii. The disinfection of vehicles accessing the farm: It is common for drivers of vehicles entering a farm to circulate in between several fish farms as they are likely to be veterinarians, feed manufacturers, fish transporter, etc. To this end, foot and wheel (vehicles, motorcycles, wheelbarrows) dips can be used for better disinfection of such things.

iv. The disinfection of equipment used in handling fish: Precautionary measures related to pathogens must be applied to all production units - ponds, tanks, hapas, or aquarium - within each farm.

- Transfers of equipment from pond to pond, hapa to hapa or tank to tank must be spaced out as much as possible, especially when it comes to the transfers of nets, which are the most likely tools to be directly in contact with fish.

v. Employee hygiene within the farm: Farm workers must regularly wash their hands; this rule especially applies to those who handle fish through sampling, grading, feeding.

vi. Placing footbaths and brushes at the entrance: Can help limit the spread of pathogens. Keeping a regularly updated register of visits also constitutes an important component of the protection process.

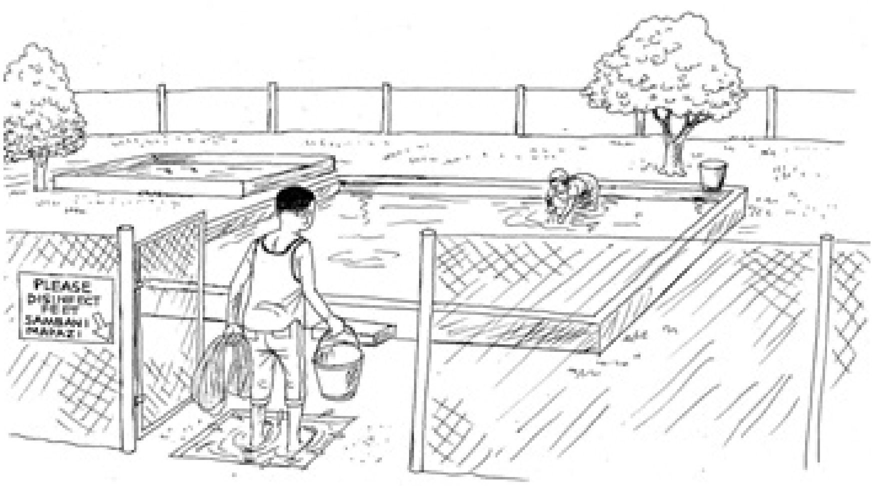



Fig 3.1 Foot or wheel bath as a biosecurity measure

vii. The removal of dead fish: Since fish are particularly likely to be contagious, their carcasses should be handled with care so the pathogens they contain will not spread. It is also of the utmost importance to isolate and destroy such fish soon after death has occurred. These guidelines constitute a first line of sanitary measures in aquaculture. Don't wash dead fish in either ponds, tanks or canals taking water to such facilities

viii. Fishing nets: It is advisable to use nets to specific ponds and not using one net in all the nets. If a farmer has only one net, it must be properly cleaned or washed and sun dried before being used in another pond.

## 3.2 Fish Farm or Hatchery disinfection

Hatchery farm disinfection is necessary for preventing and controlling fish diseases. This method is practical only at those hatcheries having a controlled water supply that is, originating in wells or springs that can be kept free of fish. The disinfection of hatcheries utilizing river water, or other public waters, would be inadvisable because of the constant danger of new infections from fish in these waters".

Disinfection should be done whenever it becomes desirable to rid a facility of an infectious agent because of production problems that agent has caused, or because of the implications of rearing and shipping infected fish. The time to disinfect is whenever the facility can be taken out of production because effective disinfection will kill fish. Whenever a particularly serious disease problem occurs at a facility, it may be necessary to destroy all stocks of fish in order to prevent further spread of the infectious agent.

A disinfectant is an agent that destroys infection producing organisms. Concentration and duration are important factors that are dependent on the conditions and procedures undertaken. Wear protective gear when handling disinfectants, and follow instructions carefully. Expired disinfectants should not be used and instead discarded properly.

### 3.2.1 Hatchery disinfection methods

i. Sanitizing Fish Tanks, Raceways, and Utensils

Clean thoroughly with chlorine/disinfectants, salt and water to remove scum and dirt. Then rinse with clean water.

ii. Fish Pond

- To control growth of algae and kill many bacteria in fish ponds
- Remove all fish from fish pond.

Then

- Lime the pond at appropriate liming rate
- Each member of the disinfection team should be provided with complete rubber outfits, including boots, coat, hat, and gloves.
- The outer garments must be removed and left on the hatchery grounds at the end of each day's work if the crew does not remain until the disinfection has been completed, and should be thoroughly disinfected before removal.

The same applies to pathogens, which are for instance bacteria or viruses, causing disease. If the immune system of fish is constantly fighting pathogens to prevent disease it may negatively affect the fish growth [link to section on diseases].

When cleaning operations have been completed, all equipment and facilities should be disinfected. All interior surfaces of hatchery buildings should be saturated with an effective disinfectant solution.

All surfaces should be scrubbed clean before the disinfectant is applied and, if necessary, the disinfectant should be scrubbed into the surface.

Fig 3.1 Common disinfectants and dosages for various applications

| Disinfectant | Concentration | Duration | Comments |
|---|---|---|---|
| Benzalkonium chloride | 250–500 ppm | 10–30 min | Plastics, floors, footbaths, walls, equipment and furnishings |
| Didecyl dimethyl ammonium chloride | 400 ppm | 5 min | Plastics, floors. |
| Ethyl alcohol | 70%–80% | 10–30 min | Hands, tools, work surfaces. |
| Phenols | 2%–5% active ingredients | 10–30 min | General disinfection. |
| Iodine | 100–250 ppm | 20–30 min | Antiseptic on tissues. Follow product label instructions if using for egg surface disinfection |
| Chlorhexidine (most solutions contain 2% active chlorhexidine) | Add 100 ml to 1 L of water for disinfection | 5–10 min | General disinfection. Commonly used for footbaths. |
| Isopropyl alcohol | 60%–80% | 10–30 min | Hands, tools, work surfaces. |
| Chlorine | 200–500 ppm | 10–60 min | All surfaces except plastic. When cleaning tanks, disinfect for 24 hours, neutralize, rinse and dry. |

### 3.2.2 Some basic Biosecurity measures

- **Fish and Animals**

When animals enter an aquaculture farm or facility, they pose significant risks of spreading the disease more especially if their health status is unknown or uncertain. Both aquatic and terrestrial animals would act as vectors of the disease and examples include: broodstock, seed, eggs and animal products, wildlife, birds, pests, and scavengers. Each fish farm should have a proper screening protocol for aquatic animal diseases for all in-coming stocks (fingerlings and broodstock) especially those from the wild. Whenever new stocks are introduced onto a farm, it is important to subject them to necessary quarantine procedures to ensure they are free from any possible diseases. Therefore, fish farmers must always have quarantine facilities at the farm. Furthermore, there is need to obtain healthy fish (fry, broodstock, juvenile, eggs, fingerling) from a reputable source and in a case of uncertainty in the health history of the fish obtained, they must be quarantined before released into our main facilities.

- **People**

It is important to understand that people including workers, staffs from other farms, visitors, contractors and other members can present a significant risk of disease transmission onto the farm. Put in place necessary measures to prevent them from bringing the pathogens or a disease if the enterprise is to be protected. Aquaculture producers in Malawi must ensure that people that enter the farm are treated as couriers of the disease and measures must be put in place to prevent diseases from coming into the farm through human beings.

- **Water and sediments**

Quality water is critical to an aquaculture enterprise and it is often said that before you farm an aquatic organism you ought to farm the water. This means that the water must have the required parameters necessary for the proper growth of fish without favoring the pathogens. Equally, the sediments have a bearing on the water especially in already used ponds. If the sediments are polluted, the water will significantly be affected within a short period of time. In land based culture nature of water supply, presence of contaminants considerably affects the risk of disease transmission onto the farm. It is thus very important to ensure that water of appropriate quality is used in the breeding and culture of fish. Additionally, the movement of water within a farm should be considered to minimize the potential for diseases to spread between different production units or populations with different health status. This is particularly important to reduce the spread of an emerging disease. That is the main reason why series ponds are not encouraged because if one pond is affected there are higher chances that even other ponds that were not affected initially would also be affected due to water moving from one pond to another.

- **Feed**

Manufactured feed or raw materials can act as source of fish disease causing pathogens. Poorly stored and handled feeds poses serious concerns. Feeds and feed ingredients are often sourced from aquatic environments and may present a risk of transmitting diseases. Different types of feed present different levels of disease risk. For example, live feeds such as rotifers, artemia and polychaetes and unprocessed whole aquatic animals may present a higher risk of disease transmission than commercially manufactured feeds. The disease status at the source of the feed or ingredients must be known.

The focus areas are:
- Whether pathogens of concern are present in the feed or feed ingredients,
- Whether the feed or feed ingredients have been treated in a way to deactivate pathogens of concern and how feed is stored.
- Proper screening should be conducted on feed materials and ingredients. The biosecurity risks to your farm and hatchery that are associated with feeds need to be considered and measures put in place to manage any unacceptable risks.
- Where live or unprocessed whole animals must be used as feeds, risks can be managed by sourcing feeds from disease free areas, by testing to ensure they are disease free or by treatment to inactivate pathogens.

- **Good farm management practices**

A good farm management practice has no substitute and requires employing knowledgeable and experienced farm workers to oversee production activities. In cases where this is not possible, the farm attendants must undergo necessarily training on good aquaculture management practices that ensures the protection of fish from disease invasion.
- The design and construction of aquaculture farms or facilities must be done in a way that will prevent risks of disease introduction, spread or leaving the farm easily.
- Stock health should be maintained by keeping stock stress to minimum level and maintaining optimum water quality.
- Water quality parameters should always be kept within the required range, and stocking density should be kept under normal based on the species being culture as well as the size of the culture facility.
- It is very important to keep records about the stock movements, in and out of the farm at all times so as to make it easier to trace the sources of disease in case of outbreaks. The use of basic biosecurity measures, such as foot dips and controlling the movement and access of people in the farm are crucial.

- **Recordkeeping**

Good record keeping is essential at a farm and in a hatchery operation. All activities must carefully be recorded to make it easier to trace or investigate an event that could have links to the possible cause of a disease outbreak. Recordkeeping must be accurate and reliable. All records must include the date of the event, a signature of the person who made the entry and any additional remarks or comments. Fish farms and hatcheries should keep records of the following activities:

- Visitors to the fish farm or hatchery
- Movement of fish from outside or within the farm or hatchery
- Purchase and introduction of new fish
- Changes in fish behaviour
- Fish mortality along with any symptoms
- Any reports on disease investigations from laboratories or reports from experts visiting the farm or hatchery
- Handling or treatment of fish
- Water quality parameters
- Training offered to staff members
- Changes in farm or hatchery operations, such as introducing new feed (source of feed, date manufactured), change in water supply, use of new disinfectant and new dosage.

## Summary

Infectious diseases of cultured fish pose significant constraints to expansion and realization of aquaculture's full potential. Viral, bacterial, and parasitic agents infect many wild and all cultured fish species. Most pathogenic agents are endemic to natural waters where, under normal conditions, they cause no great problem. However, when these same diseases occur in an aquacultural environment they may cause significant disease and mortality. Biosecurity measures that are based on a better understanding of various disease risk factors in an aquaculture farm may provide a more effective result. Some of the major risk factors that need to be seriously taken into consideration include fish, animals, people, vehicles and other moving equipment, water and sediments, feed, and solid and liquid wastes. Proper handling, sourcing of ingredients and storage must be prioritized in an effort to ensure quality of the feed is not compromised. Record keeping in all stages of operations must be done. Therefore,

# FISH HEALTH AND MANAGEMENT

Module III of 8