AQUACULTURE EXTENSION MANUAL NEW SERIES NO. 9 • DEC. '85

IDENTIFICATION AND CONTROL OF COMMONLY OCCURRING DISEASES IN FRESHWATER AQUACULTURE

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ISSUED BY : **Information and Extension Divisions of CIFRI.**

PUBLISHED BY : **D. D. Halder** *on behalf of*
The Director,
Central Inland Fisheries Research Institute,
Barrackpore-743101, India.

ISSUED IN DECEMBER 1985.

Printed by : Roman Printers
37 Andul Road, Howrah-711 109 Phone : 67-6126

FOREWORD

The country is well poised for adoption of aquaculture in freshwater ponds and tanks on a large-scale. The Government of India, State Governments and voluntary agencies are taking keen interest in development of freshwater aquaculture in this country. CIFRI's aquaculture technologies are now available in this country to achieve higher productivity from freshwater bodies. Farmers and entrepreneurs are increasingly coming forward to adopt carp polyculture as well as air-breathing fish culture. Fish diseases are contingent upon intensive fish culture which implies large-scale stocking, supplementary feeding, etc. The fish farmers and entrepreneurs are likely to encounter fish diseases caused by protozoans, crustaceans, trematodes, cestodes, viruses and bacteria. In addition to that many diseases are also caused due to environmental degradation and nutritional deficiency. In this manual the authors have taken effort to project these aspects together with information on identification of parasites, signs of diseases, curative as well as prophylactic measures accompanied by suitable illustrations, text figures and photographs. It is hoped the manual will be very useful to the practicing farmers and extension workers.

A. V. Natarajan
Director

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IDENTIFICATION AND CONTROL OF COMMONLY OCCURRING DISEASES IN FRESHWATER AQUACULTURE

R. N. Pal & A. K. Ghosh

1. INTRODUCTION

The occurrence of fish mortality in ponds and tanks is a common phenomenon and is as old as the practice of fish-culture itself. The advancement of knowledge in fish culture has enabled man to harvest more fish under crowded conditions. As a result, the incidence of fish mortality is also on increase consequent to intensive rearing of fishes under conditions leading to physical and physiological stress. Changed environment due to intensive manuring and fertilization, usage of abundant quantity of supplementary feed etc., also adds to the stress making fishes more vulnerable to diseases.

In India, occurrence of fish disease has not yet been of alarming nature compared to industrially adavanced countries where intensive fish culture is practised on a large-scale. The Central Inland Fisheries Research Institute has been investigating different causative factors of fish mortality including degradation of pond environments, pathogens and their prophylactic and remedial measures. The present communication gives in detail the manifestation of fish diseases and their control with particular reference to the pathogens of cultivated species with a view to benefit the ever increasing pisciculturists and fish farm managers in our country.

2. BEHAVIOURAL INDICATORS OF DISEASED FISH OR FISH STOCK

Any occurrence of fish disease in a water body is generally recognised by the fish becoming restless, rubbing its body against the pond dykes, splashing, surfacing, whirling, non-acceptance of food, sluggishness in movement, vertical hanging, etc. These are some of the abnormal behaviours which are the forerunners of any disease outbreak. It is at this stage that a pisciculturist must be alert and try to have the services of a fish pathologist to save his fish stock.

3. PARASITE-HOST-ENVIRONMENT RELATIONSHIPS

Monitoring of environment (rather water quality parameters) is extremely important for success in pisciculture. Sudden change in the aquatic environment may cause stress on the fish stock which will act as a predisposing factor for the outbreak of a disease. Under crowded condition fish become more prone to pathogens. As such regular fish health monitoring becomes a must under intensive rearing. The general health of a fish-stock depends largely on the various physico-chemical parameters viz. light, temperature, turbidity, dissolved gases, nitrogenous wastes and metabolic products etc. This also depends upon managerial practices like stock-manipulation, feeding, disease control, etc. In other words, wide fluctuations in physico-chemical condition of environment or any loophole in stock-management may lead to stress and ultimately an outbreak of disease.

4. DISEASES CLASSIFIED

Diseases of fishes may be grouped in five categories as follows :—

(a) Environmental fish diseases

(b) Pathogenic fish diseases

(c) Nutritional fish diseases

(d) Managerial fish diseases and

(e) Congenital fish diseases

4.1 ENVIRONMENTAL DISEASES OF FISHES

Any one of the following adverse environmental conditions may create a problem leading to fish diseases :

(i) Supersaturation of dissolved gases *viz*. oxygen, nitrogen, carbon dioxide, hydrogen sulphide and argon.

(ii) Phytoplankton bloom or zooplankton swarms leading to depletion of oxygen.

(iii) Water temperature rising to lethal limit.

(iv) Pollution by organophosphorous/organochlorine pesticides or any other chemical.

(v) Toxicity of ammonia (NH_3) in water.

Some of the above mentioned factors can lead to fish mortality. Surfacing of fish during early morning of summer months, particularly when the sky is overcast is a common experience. However, in case of depletion of oxygen the fish keeps its mouth wide open and the gills look pale. When the nitrogen content, particularly ammonical-nitrogen, is high, the gills look dark red due to the formation of methaemoglobin, a combination of nitrogen with haemoglobin. Both zoo- and phytoplankton may cause depletion of oxygen at night when the fish stock will show the symptoms like surfacing and gasping. Excessive secretion of mucus by a fish is encountered when carbon dioxide or pH level in a pond is high. Such a symptom is also shown by a fish when it is attacked by some external parasites or epizoans. Bottom dwellers come up to the surface first when hydrogen-sulphide gas is accumulated at the pond bottom. This gas gives the smell of a rotten egg and the same may be tested if the mud of the pond is smelt.

Algal toxicosis is often encountered in ponds where extensive fish culture is in practice. This happens due to accumulation of lot of organic matter in the pond and thereby affecting pond productivity. Algal bloom may also appear in a pond due to excessive chemical fertilizers. Toxins released by blue-green algae like *Microcystis, Anabaena and Aphanizomenon*, cause surfacing of fish-stock very often. Algal bloom of such species will kill other phytoplankton and this blooming has a direct relation with the increase of pH of the ambient water. The bloom of blue green algae gives a pea-soup colour to the pond water. Persistence of the bloom will cause toxicosis for the fish stock therein as a result all the fish will show the symptoms like convulsions leading to death. Smaller fishes die first between 9 a.m. and 4 p.m. due to supersaturation of oxygen (i. e. more than 9 ppm in the water).

Accumulation of gas-bubbles within the body cavity of fish spawn due to supersaturation of oxygen or nitrogen in the pond-water has also been recorded on several occasions. Such cases have mostly been encountered from hatching hapas fixed in ponds having abundant green algae which release oxygen during sunny weather.

Similarly, zooplankton swarm may cause depletion of oxygen in the pond during early hours of the day when the fish-stock will come to the surface and gasp for more oxygen. The bigger fish die first due to increased demand of oxygen for basal metabolism.

In sunny days mortality of fishes does occur in ponds due to high temperature of water. Every fish has a tolerance limit, when it is crossed the fish shows the alarm syndrome initially, i. e. coming up to the surface, splashing water and finally looking exhausted, sinking to the bottom. Indian minor carps die when the temperature is 39°C and air-breathing catfishes (*Clarias batrachus* and *Heteropne ustes fossilis*) get exhausted at 42°C. Temperature of water has inverse relation with the dissolved oxygen ; more the temperature less is the oxygen available for the fish. This phenomenon is more pronounced if the pond water contains very few green-algae which release oxygen by photosynthesis. A zooplankton swarm may create such a problem because the same is the first line of consumer. Application of algicide, manuring with fresh cow-dung or usage of chemical drug also kills phytopankton in fish ponds. As such,usage of these materials may cause a havoc in a fish pond.

Temperature helps in solubility of pesticides, heavy metals and crude oils in water. As such these chemicals can pollute the water if get mixed per-chance. Pesticides have polluted fish ponds on many occasions. If the same is due to any organo-chlorine pesticide then the moribund fishes may show the symptom of oozing blood from their eyes ; but fish poisoned by organo-phosphorus pesticides will loose balance due to drooping forward of pectroal fins towards anterior side of the body.

Temperature below or above the optimum limit of a fish, stops production of antibody in the system and thereby the fish looses its defence-mechanism and gets more susceptible to diseases.

Though light plays a great role in the growth and maturity of a fish but excess of sunlight may stop photosynthetic activity in a fish pond and this probability is more in our tropical country. As a result depletion of oxygen and a brake to the natural productivity of a pond are inevitable.

Best growth of fish is expected in water having a pH range between 6.8 and 8.6 But trace elements remain best in available from in neutral waters.Moreover, in acid waters the carrying capacity of haemoglobin of a fish is greatly reduced, as oxygen is less soluble in blood plasma haemoglobin binds the same for active transport. Oxygen is more needed for a fish during its food intake and digestion. As such, acid waters can easily affect a fish. That does not necessarily mean that a more alkaline water is preferred for fish culture. In more alkaline waters toxic ammonia is formed in the fish-environment. For healthy growth of a fish-stock, the total ammonia (free NH_3) in its environment should not exceed to 0.002 ppm. Thus in acid waters carbon dioxide and in alkaline waters ammonia attain toxic limits to cause fish mortality.

Prevention against environmental diseases

It has already been stated that environmental diseases may appear in fishes of warm water due to one or combination of various factors, like too much bright sun, overcast sky, phytoplankton bloom, depletion of oxygen resulting to fish-mortality. The instances mentioned above, prove beyond doubt that there is a great need to keep the environment clean, otherwise the same may provide optimum condition for the fish pathogens to multiply and thereby expose the fish most to diseases. Proper sanitation can be done by removing muck from pond-bottom regularly and exposing the bottom soil to the sun. Such measures cannot be taken in a deep perennial pond. During summer months, when water level in such a pond remains lowest, application of lime and potassium permanganate may be used in maintaining sanitation. Liming sould be done after determining the pH of pond-soil which is also reflected in its water. In 'bheries' (man-made shallow vast impoundments by the side of tidal rivers or creeks) removal of organic matter, exposing the soil to the sun for a month and thereafter ploughing may check mortality of 'bagda' (*Penaeus monodon*). Liming of pond has become a must in maintaining sanitation in nursery, rearing and stock ponds.

Liming can also been done in waters containing more carbon-dioxide. Carbon-dioxide combining with hydrogen forms a poison (HCO_3) which may be avoided by liming. Because lime will combine with HCO_3 to form bicarbonate which is not toxic. Carbon-dioxide gets saturated due to more chemical activity in a pond. As such, care should be taken in this regard.

Both primary producer (algae) and primary consumer (zoo-plankton) need to be kept under control ; otherwise supersaturation or depletion of oxygen may create a problem. Both supersaturation and depletion of oxygen can be kept under control if these are not allowed to form, which is manoeuvered through restricted use of manure, fertilizer and fish-feed. It has been found that sprinkling of water containing fresh cowdung (200 kg/ha) may control phyto-plankton bloom. Copper sulphate (0.5 ppm) solution can also serve the purpose but it is highly toxic and remains in the pond soil for long. As such the same may be used, taking proper precaution.

4.2 PATHOGENIC DISEASES

A pathogen is generally an organism either plant or animal that causes disease to its host. Virons and bacteria both are pathogens but none of them is recognized as plant or animal. Viral diseases of fishes have so far not been identified in our country rather they have escaped our notice but few cases of bacterial diseases have been identified. Fungal and animal parasites are taking a heavy toll from our nursery, rearing and stocking ponds. So an attempt is made to give an idea of those diseases and their remedial measures.

4.2.1 **Bacterial diseases**

Though in foreign countries many bacterial diseases are diagnosed by definite symptoms and clinical signs, very little work on these lines has been done in our country. Excepting bacterial Eye-disease of catla (*Catla catla*) no other bacterial disease has been confirmed through passaging of bacterial strains. However, a *Flexibacter columnaris*-like pathogen has also been isolated. As such, the bacterial diseases of indigenous fishes will be dealt here as a general one.

Eye disease of catla

This disease has been encountered in epidemic proportions from ponds having a heavy load of muck at the bottom. Causative organism is a strain of *Aeromonas*. At the initial stage of pathogenesis eyes look reddish due to vascularization and finally have cloudy lenses. Bacterial cataract is obvious in both eyes whereas nutritional cataract can be recorded from one of the eyes.

Dropsy of Indian major carps and commercially important catfishes

Dropsy can be recognized by the accumulation of water in the body cavity or in the scale pockets. Such a symptom develops when the osmoregulatory mechanism of kidney fails to filter water. Freshwater fishes drink a lot of water, and when the same is not excreted as almost ion-free urine, a fish suffers from dropsy.

Aeromonas is also responsible for causing dropsy among catla, rohu (*Labeo rohita*) mrigal (*Cirrhinus mrigala*). But etiological agents causing dropsy among magur (*Clarias batrachus*) and singhi (*Heteropneustes fossilis*) have not yet been properly identified. Presumptive identification has been done and *Pseudomonas* is the probable pathogenic agent causing dropsy.

Loss of barbels in singhi and magur

When singhi or magur is stocked heavily in ponds and they are fed intensively the environmental condition generally deteriorates due to accumulation of metabolites, faecal matters and unused feed (if the abmient water is not frequently replenished). So a favourable condition is provided for bacterial multiplication and simultaneous "stress" for the fish stock. This is manifested as a bacterial disease which is reflected in the loss of barbels among singhi and magur. Initial symptom is slight putrefaction of the tip of the barbel which looks reddish at the site of infection and proceeds towards the snout. Finally the barbel is completely lost. Dropsy is sometimes associated with this disease.

Ulcers

These are small sores on the body of a fish. Initially they look like a small pimple and ultimately when the epidermal cells as well as scales are lost the sores become conspicuous. Such sores have been encountered both in Indian major carps and commercially important catfishes. The etiological agent as recorded from catfishes, is *Aeromonas*. If the affected stock remains non-medicated, the sores go deeper in the body exposing the muscles and finally the vertebral column.

Tail and fin rots

Bacterial rots differ characteristically from fungal rots. Bactreial rots are generally caused by myxobacters and *Aeromonas* spp. It is not known whether they are primary invaders. Some workers consider that 'stress' might be making the fish weak and affecting its immune system. As a result the fish becomes an easy victim of these bacteria. There is another school that believes that higher concentration of certain chemicals in water is the predisposing factor for bacterial rot disease. However, when the fins are affected with bacterial rot a whitish margin of the fin is noticeable. If care is not taken, rather fishes are not medicated either with bacteriacidal or bacterostatic drug then the rot proceeds towards muscular portion of the fish.

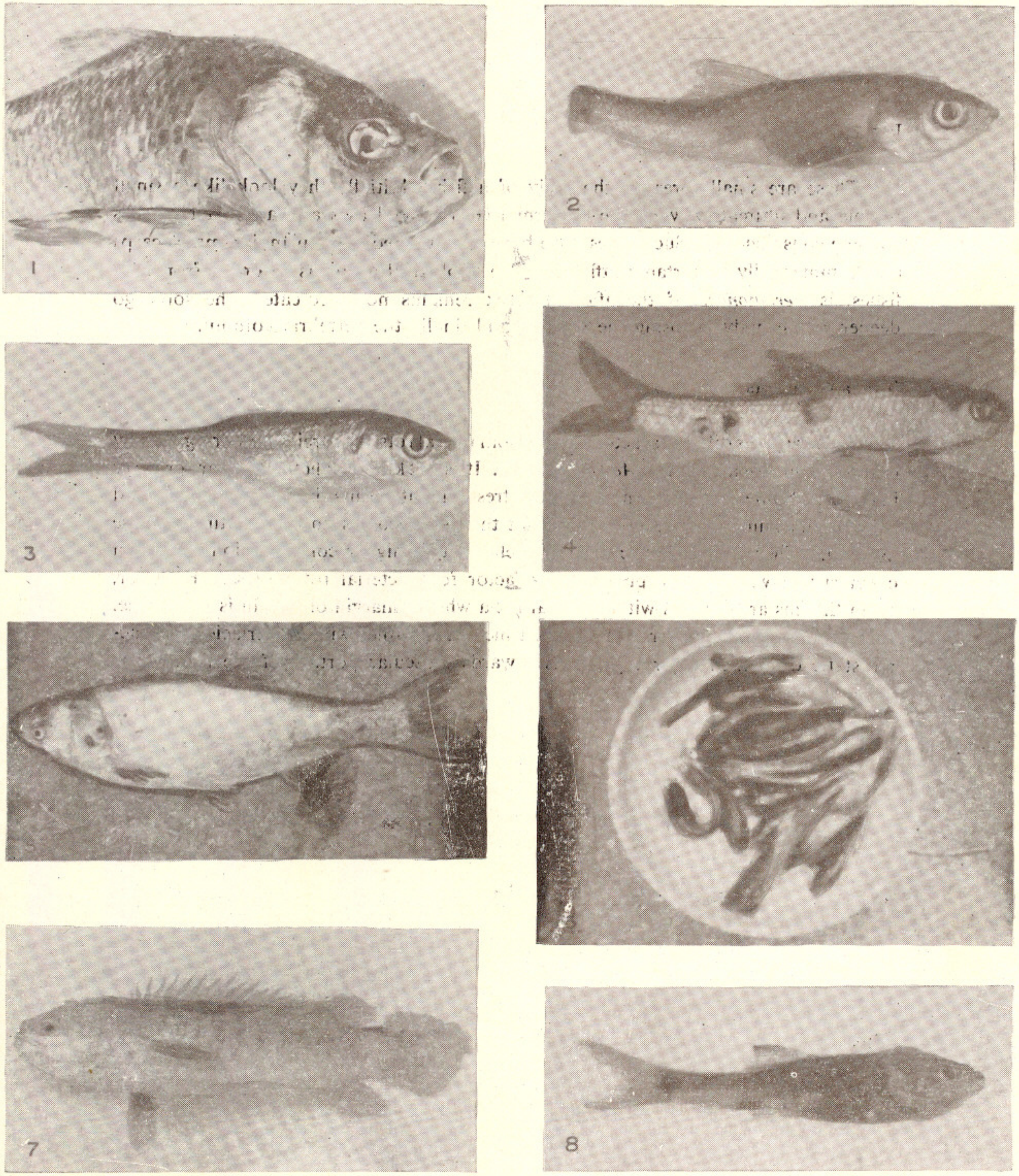

FIG. FISHES FROM CULTURE PONDS SHOWING DISEASES.

1. **Eye disease of** *Catla catla*
2. **Tail rot of** *Cirrhinus mrigala*
3. **Dropsy of** *Cirrhinus mrigala*
4. **Ulcer of** ,, ,,
5. **Reddish blotches of** *Hypophthalmichtys molitrix*
6. **Loss of barbels and dropsy of** *Clarias batrachus*
7. **Tumours of** *Anabas testudineus*
8. **Gill fungus of** *Cirrhinus mrigala*

Tumours

Tumours are of two types, carcinogenic and noncarcinogenic. Virons are generally responsible for carcinogenic tumours. But tumours, often recorded from *Anabas testudineus* (*Koi, Kaoi*), are generally caused by bacteria which may not be the principle causative factor. When the stocking density of the fish is more and its environment is laden with organic detritus a congenial environment is provided for the rapid multiplication of these bacteria. As a result the fish stock suffers from such a disease. At the first stage a small tumour appears on the snout or on the dorsal/ caudal fin. If the stock is not treated at this stage, the number of tumours on the body increases resulting in the mortality of the affected fish.

4.2.2 **Fungal diseases**

Fungal diseases are often encountered in hatching 'hapas', hatcheries and less common among bigger fishes. There are four species of fungus *viz. Saprolegnia, Achlya, Ichthyophonus, Branchiomyces* causing diseases in fishes which are manifested in various forms. Branchiomyces causes branchial disease. *Ichthyophonus* is generally encountered from hatcheries, whereas *Saprolegnia* causes both hatchery disease as well as fin rots. In every occasion a tuft of fungal mycelia is discernible to the naked eye. However, these mycelia are mostly secondary invaders. They appear on dead eggs, affected gills and fins.

4.2.3 **Animal parasites**

There are many animals which live on fishes but it is not always known whether all of them are parasitic or commensal in nature. Excepting a few unicellular and a few multi-cellular organisms, most of them do not cause much harm to their hosts. Most of the chronic diseases of fishes are cuased by animal parasites. *Myxosoma cerebralis* and *Ceratomyxa shasta* are the two unicellular organisms causing acute diseases of cold water fishes.

Protozoan diseases

Many protozoans have been recorded from fishes ; some of them are termed external and others are internal parasites. Among the external parasites, *Costia* and *Trichodina* are causing some harm to fish fry. Myxosporidians live either as external or internal parasites on fishes. These are most successful parasites which use their hosts for a pretty length of time for their sustenance and rapid multiplication. The diseases manifested by these parasites are described below :

Costiasis

Costia (*Ichthyobodo*), a mastigophore, is so minute that it often escapes our notice. It normally lives on pond fishes but if they are allowed to proliferate vigourously, a disease manifestation may occur; or if the environmental condition of a fish is adverse and thereby the fish looses its resistance against pathogens disease symptoms appear. Costiasis is recognized by the listless condition of the fish. Loss of appetite is another symptom. The fish becomes restless and secretes more mucus (thereby keeps the parasite hidden) when the infection is heavy. However such a heavy infection is seldom encountered when a fish looks very much emaciated with a comparatively big head.

Trichodinasis

Like *Costia*, *Trichodina* is also a free-swimming organism and may not be an obligate parasite. However, these parasites are often recorded from pond waters particularly during rains and in winter. These ciliate parasites cause frayed-fins of the host. Initially the fish shows the symptom of restless condition when its epithelium secretes more mucus to wash off the parasite. If this defence-mechanism fails *Trichodina* gets a firm lodge on the host and proliferates by binary fission. When the parasites are too many in number they may use the gills of the host. As a result excessive secretion of mucus by the gill epithelia cause asphyxia for the fish. At this stage the fish may exhibit the symptom of tail-chase ; on clinical examination, clubbed gill filaments or wornout gill epithelia are found. The parasite seldom attacks hosts above 150 mm in length.

Ichthoyphthiriasis

Ichthyophthirius, commonly called as 'Ich', is sometimes recorded from warm water carps but frequently from cold water pisces. 'Ich' is an obligate parasite of fish and has a complicated life cycle. Mature *Ichthyophthirius* drops off from the host's body and reahcing the pond soil it starts multiplication by binary fission. From each cyst approximately 2000 tomites may come out and invade the host. They multiply vigourously at 20°C. and slowly at 10 deg. C.

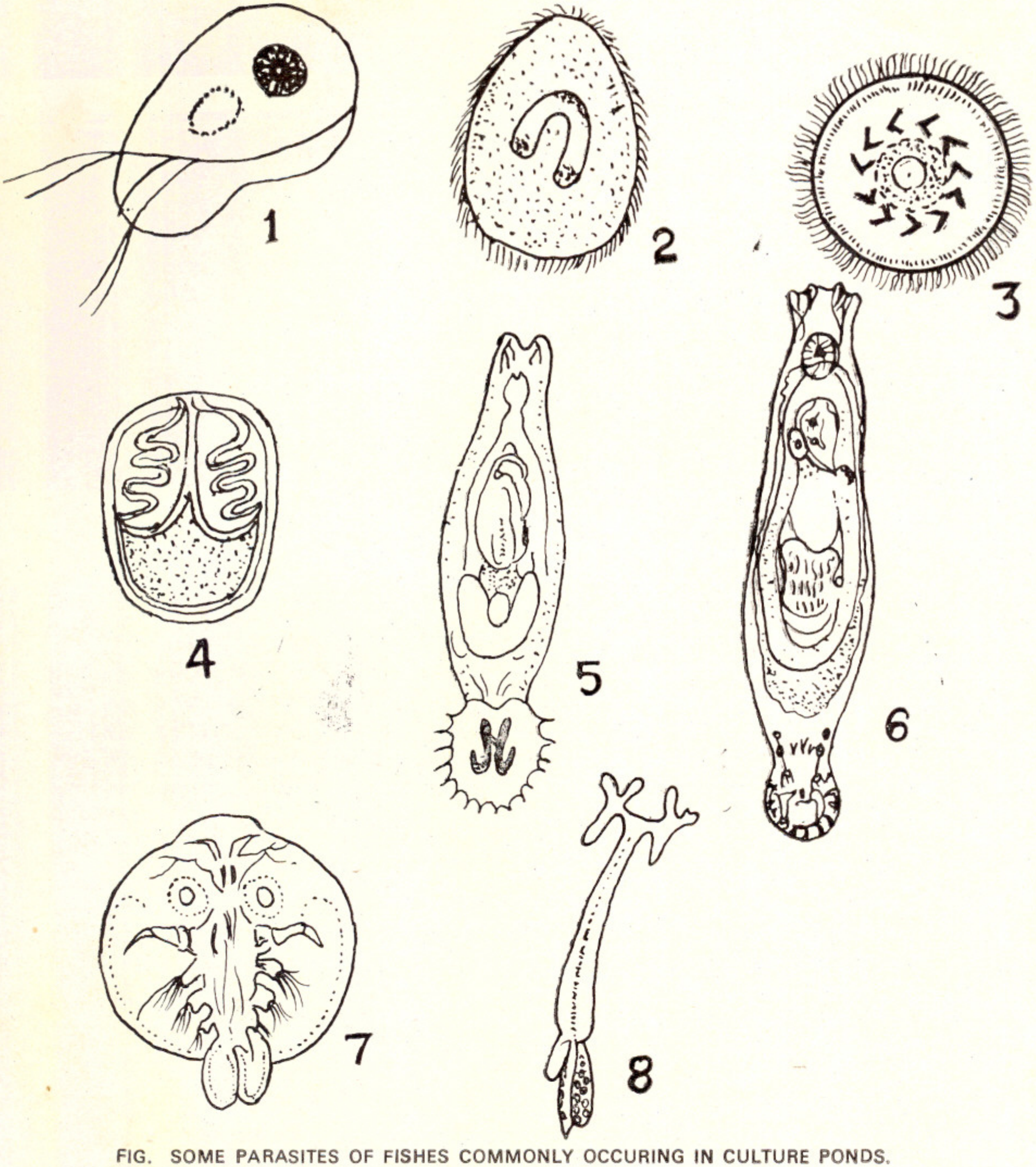

FIG. SOME PARASITES OF FISHES COMMONLY OCCURING IN CULTURE PONDS.

1. *Costia*
2. *Ichthyophthirius*
3. *Trichodina*
4. *Myxobolus*
5. *Gyrodactylus*
6. *Dactylogyrus*
7. *Argulus*
8. *Lernaea*

'Ich, a small (pin head) greyish white cyst, can be encountered from skin, fins and gills epithelia. Once a fish is affected with 'ich', it shows the symptoms of restlessness, splashing and erratic spurts because of the irritation caused by the parasite.

Myxosporidiosis

Many species of myxosporidian parasites have been encountered from indigenous fishes. The commonly found forms belong to the genera *Myxobolus, Thelohanellus, Myxidium, Henneguya, Chloromyxum* etc.

Myxosporidiosis is most common among fishes belonging to the size range of 41-150 mm, though the minimal sizes when catla, rohu and mrigal receive such an infection are 9, 18 and 17 mm respectively. The parasites appear in ponds with the onset of monsoon but the intensity of infection reaches the peak (70-100%) during the months of October ; a second peak is also eacountered during spring but the disease is seldom noticed in summer months. During winter or when water temperature falls below the optimal level of fish growth, the fish-stock looses appetite and resultant vitality, as a result it becomes an easy prey of the parasites.

Common symptoms of the disease are presence of small white cysts over body, particularly at the base of the fins and on the gills of the fish. The parasites are often recorded from internal organs. Clinical examination will reveal thinner or perforated scales with the loss of chromatophores. Both trophozoites (feeding stage of the parasite) and cysts (multiplication stage) are encountered from gall bladder, kidney etc. Excessive, secretion of mucus, wseakness and emaciation are the other symptoms exhibited generally by the hosts.

Helminth parasites

These parasites can be divided broadly under two categories : flat-worms and round worms. Flat-worms are again subdivided as Trematodes (flukes) and Cestdes (tape-worms). Flukes are of two types. Monogenetic trematodes complete their life cycle only on one kind of host whereas digenetic trematodes need more than one hosts to complete the same. Cestodes too have a complicated life cycle.

Round worms too are sub-divided as Nematodes and Acanthocephalans. The latter is termed as thorny-headed worm and its thorns definitely cause some histopathological manifestations of the host but nematodes may be commensals as well.

Among all these parasites only a few are known to cause diseases of cultivable fishes, though monogenetic trematodes take a heavy toll from carp nursery and rearing ponds.

Monogenetic trematodes

Most commonly encountered fish parasites are *Gyrodactylus* and *Dactylogyrus*. The former is viviparous, that is it gives birth to young ones directly, whereas the latter lays eggs in good numbers. Both of these kinds are identified by their attaching organ, termed as haptor which has 2 anchor hooks and 16 marginal hooklets. *Dactylogyrus* has two pairs of eye-spots as well.

The parasties start appearing in the ponds during rains but their prolific multiplications take place during winter when the intensity of infection on carp fry may reach as high as 94%. The minimal sizes of catla, rohu and mirgal infected with these parasites were recorded as 48,49 and 31 mm respectively, though the most infected size group, irrespective of the species, was 61 to 100 mm. Mortality of fishes was generally recorded within this size group during the months of December and January. The rate of infection starts declining with the approach of summer and complete disappearance of these parasites are noticed during the period between April and June, when the fingerlings get back their appetite and grow bigger in size i. e. more than 150 mm in length.

Diseases caused by *Gyrodactylus* and *Dctylogyrus* are commonly termed as Gyrodactylosis and Dactylogyrosis respectively. The common symptoms of these diseases are fading of colours of the infected fishes which are more silmy compared to the non-infected ones. Drooping and folding of fins are often encountered among infected fishes when they are also very feeble and often rest near the pond margins and obviously they remain on the surface of water. As the parasites invade the gills of the host so the latter exhibits pale-gill which is commonly mistaken as a suffering from depletion of oxygen.

Digenetic trematodes

Several thousands of digenetic trematodes have been encountered from fishes and a few more are daily described as new species. However, only a few are noted to cause harm.

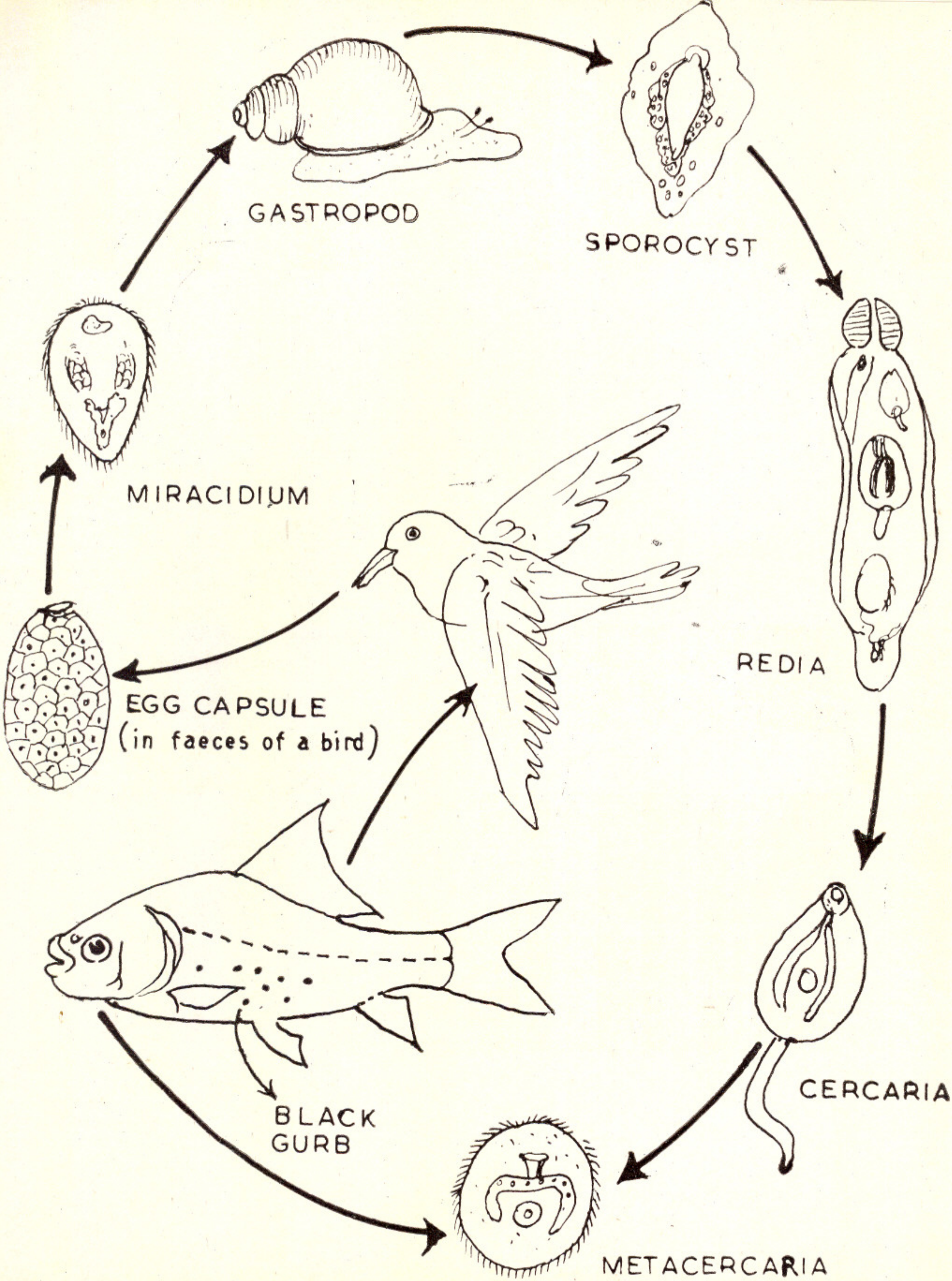

FIG. PROBABLE LIFE-CYCLE OF A DIGENETIC TREMATODE

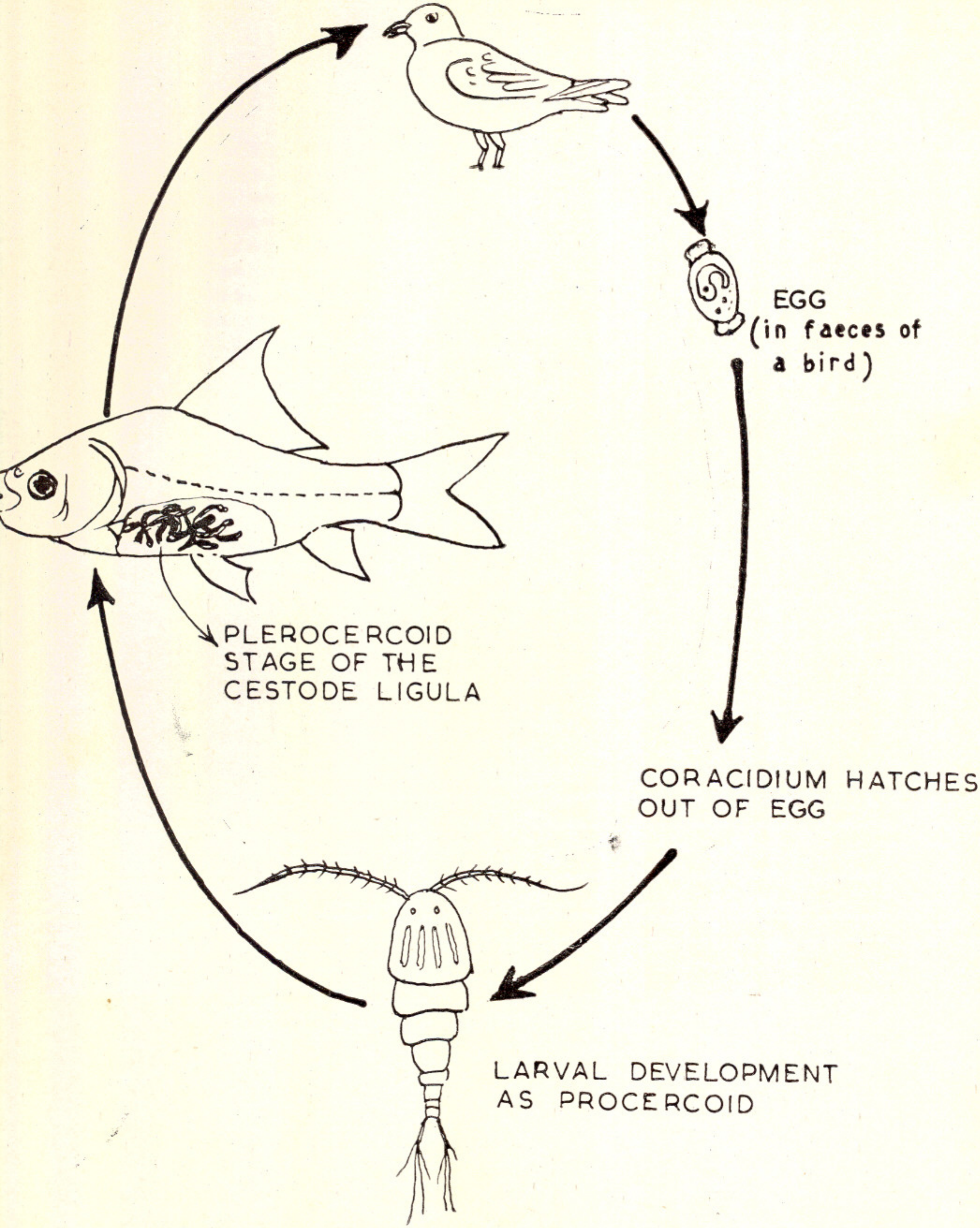

FIG PROBABLE LIFE-CYCLE OF *LIGULA*

Diseases caused by digenetic trematodes are commonly termed as white, black or yellow gurb depending upon the colour of the small pimple on the skin epithelium of the hosts. Such cysts are often seen on the commercially important catfishes, *Clarins batrachus* and *Heteropaeustes fossilis*, collected from open waters during summer months. However, no mortality of fish due to such diseases has ever been recorded from Indian waters though growth of catla of Tilaiya reservoir was found retarded due to black gurbs and very often market price of these diseased fishes go down considerably. Cutting the trees around the fish farm and making the area free from fish-eating birds could control black gurb disease in North India.

Cestodes

Generally the larval forms are recorded from fishes as birds and mammals are generally the final hosts of cestodes or tape worms. Of the cestode parasites, only *Ligula intestinalis* has been found to cause harm to catla of Tilaiya reservoir. *Anhinga melanogaster*, a bird of this region, is found to be the final host and copepod is the other intermediate host. The larval form, recorded from catla, is harmful. Adult forms, generally encountered from other fishes, seldom have detrimental effect. Fish mortality due to cestode infection in a tank at Nagpur is recorded which may be considered as a solitary one.

Ligulosis

The symptoms exhibited by the infected fish are sluggishness and slight distension of the abdomen. Such symptoms are often over-looked by the common pisciculturists ; as a result infection of cestodes from pond fishes is seldom reported though cestode cysts from alimentary canal and gall bladder of such fishes are sometimes recorded.

Nematodes

Nematodes are often recorded from fishes. Their larval forms often restrict their proper identification and no histopathlogical manifestation on the intestinal epithelia of fishes has ever been reported. As a result these animals have drawn very little attention of the pisciculturists. They are on record because of academic interest.

Acanthocephalans

Throny-headed worms have often been recorded from both fresh and brackish-waters of this country. *Acanthogyrus* and *Pallisentis* have been found to cause some harm to Indian major carps and commercially important murrels respectively. As these parasites inhabit the alimentary canals of their hosts and no specific symptom is exhibited by the hosts, pisciculturists seldom take a note of these worms. Thorny headed worms use their hooks for attaching themselves on the intestinal epithelia of their hosts. These worms lay many eggs and when they multiply in large numbers, ultimately the host gets very much emaciated due to parasitic infection.

Fry of parsia (*Mugil / Liza parsia*) collected from riverine sources, has often been found infected with juvenile forms of acanthocephalan parasites. Acanthocephalans have a complicated life cycle and generally pass their larval stages in crustaceans.

Leeches

Leeches are seldom recorded from cultivable species ; however, they are often encountered from carps collected from swamps of Bengal and Assam. Highly infested fishes get emaciated but no large scale infestation is so far observed due to such an infection.

Copepods

The fresh and brackishwater post-larval forms of fishes often use copepods as their natural diet though the food habits change when they grow bigger and attain fry stage. However, there are few forms of copepdos, visible to the human naked eye, causing diseases to the fishes. Both *Ergasilus* and *Lernaea* have been reported to take a heavy toll even from the stocking ponds of carps. *Caligus* is another species recorded though rarely from brackishwater specimens belonging to the genus *Mugil*. Freshwater parasitic copepods are recorded from ponds laden with much organic load. The primary infestation of such parasites often provides a congenial environment for the secondary invaders like bacteria and fungus.

Lernaea is commonly known as an anchor worm. This is also a macroscopic animal and easily observed without any aid. The parasite is a small white pin like organism attached to the fish body in an angular fashion. When the parasite bears two egg-sacs, it is more conspicuous. However, infection of *Lernaea* is not often recorded. Such parasites are generally recorded from heavily polluted sewage-fed bheries and ponds with much organic load.

In semi-intensive culture of carps *Ergasilus* sp. was found to infest *L. rohita H. molitrix*, *C. idellus* and *C. catla* In all the fishes the ectoparasite infested the gills and body surface. The parasite attaches intself by its strong clawed second pair of antenna and feeds on the blood and epithelium of the host. Prominent pathogenic manifesteation was damaged gills, impaired respriration and retarded growth. As a result heavily infested fishes show heavy secretion of mucus, surfacing and sluggish movement and consequent mortality. The mature forms are mostly obtained during summer and winter months.

Ergasilius sp. was found to infest the gills of *Liza parsia* from Bheri waters.

Caligus is rarely recorded from the *Mugil* spp. Badly infested fishes show the symptom of emaciation. As they are macroscopic parasites they are easily noticable. They are bigger in size compared to *Argulus* and have spots on their exoskeleton (shell).

Branchiura

Argulus, commonly known as a fish-louse, is a free swimming parasite and can live a pretty long time for the search of a suitable host. The form is round and transparent ; as such it is confused with scale but on careful observation its suckers, two blackish spots, are distinctly visible. Being a mobile parasite it also exposes its detection. Penetrating its sucking apparatus and injecting a cytolytic substance through the same the parasite draws its nourishment from the fish body. As it is easier to draw nutritive jiuce from the gills, it reaches the gill epithelia of the fish as well. The parasite lays eggs in large numbers ; as such their rapid multiplication and parasitism cause irritation for the host which is exhibited by rubbing the body (host's) against the pond bank. Long sufferings result emaciation and pigmentation for the host.

ISOPODS

Bopyrus

These parasites are often recorded from the prawns and shrimps of both fresh and brackishwaters. Not much is known about these parasites. They get attached on the branchiae of the shell-fishes and cause destruction to both somatic and gonadal development of the host.

Alitropus

This parasite has been recorded though rarely, from *Wallago attu* collected from the natural waters. The parasite has recently been recorded from carps cultured in fish farms of Andhra Prodesh. However, the parasite has not drawn much attention of the fishery-workers as it does not cause much harm to its host.

5. REMEDIAL MEASURES

Before anything is told about the remedial measures it must be mentioned that chemotherapy is the last method to be resorted to. It should also be kept in mind that the chemicals which are generally used for chemotherapy have a toxic effect. Sodium chloride or common salt which appears so harmless can kill a fish when it is kept in 3 per cent saline for a longer period. As such, before using any chemical its lethal level or toxic limit is better to ascertain first.

It has been found that diseases of fishes are generally caused in pisciculture due to bad managerial practices *viz.* higher stocking density of fish, non-supply of supplementary feed (as each pond has its own productive level suitable for culturing a certain number of fish), hauling stress, callousness to fish-health etc. Death of fish may also occur due to bad environmental condition *viz.* depletion or supersaturation of oxygen, higher concentration of gases like carbon dioxide, nitrogen, ammonia, hydrogen suffide, etc. Sometimes organo-chlorine or organo-phosphorus pesticides used in neighbouring agricultural plots get washed off in rains and fall in fish-ponds causing fish mortality. All such calamities can not be easily avoided if the managerial practices are poor.

However careful a pisciculturist may be, chemotherapy is almost unavoidable for getting rid of diseases of his fish stock. The diseases mentioned earlier are mostly of chronic type. Such diseases shall never cause fish mortality *en masse*. Surfacing and erratic movements of fishes or their lethargy or loss of appetite are the first symptoms which should not be overlooked. Earlier the disease is diagnosed, easier the control ; though prevention is always better than cure.

Generally two methods are followed for treating the fish stock :

(i) Using the medicine along with the diet and

(ii) Immersing the fish stock in water containing the medicine.

Sometimes as a remedial measure, the pond is treated with a chemical, though it is not very economical.

The antibiotics and chemicals which are generally used in pisciculture are mentioned below along with the application dosage and method.

5.1 **Terramycin**

This is the most useful drug against the bacterial infection of fishes. In India, many bacterial diseases could be controlled using 100 mg of Terramycin/kg. of fish feed where the feed is generally supplied @ 3% of the body weight of fish. The treatment is continued for a period of one week. Generally 'Terramycin paediatric tablets (Pfizer) is used but the 250 mg capsules can also be used. The chemical is mixed with water and the mixture is used in the feed to make the dough. However, it should also be borne in mind that once the antibiotic is used, its proper dose and course should be followed otherwise the bacteria may develop resistance against the drug.

5.2 **Sulphadiazine**

This drug is found to be very useful for controlling ulcer disease of magur (*Clarias batrachus*) caused probably by *Pseudomonas* sp. Sulphadiazine tablet (May & Baker) weighs 500 mg each. The tablet can be finely powdered and mixed in the supplementary feed. The dose is 100 mg of the drug per kg. of feed supplied to the fish stock. Medication should be continued for a period of one week.

Malachite green

This chemical is very much effective against fungal disease of fishes and fish eggs. The chemical is dissolved in water and this stock solution is spread all over the surface of the pond which is then thoroughly stirred by repeated netting. For every million part of water only, 0.1 part of malachite green is added and the treatment is done on alternte days for four such treatments. To make the calculation easy it may be said that 0.1 gm chemical is to be added for every thousand litre of water. How to calculate this volume of water is to be stated later.

Formalin :

Though this chemical is very much corrosive and perhaps carcinogenic in nature its use in pisciculture cannot be avoided. In low temperature, formalin turns to a more poisonous form. The commercially available formalin is nothing but a solution of 37 g formaldehyde in 100 ml water. In low temperature formaldehyde turns to paraformaldehyde which is very much toxic. While in solution paraformaldeyhde settles at the bottom of the container and if stored in a transparent glass bottle, the whitish powdery layer settled at bottom is quite conspicuous. As such, while using formalin a careful observation has to be made to avoid poisoning. Formalin is exclusively used to get rid of external parasites and particularly the monogenetic tremotodes. Affected fry or fingerlings can be dipped in water containing formalin at a concentration of 200-250 ppm (depending upon the size of the fish). Dipping is continued till the fish stock does not show the symptoms of restlessness when the same is released in freshwater. The chemical can be directly used in ponds when formaldeyhde concentration should not exceed 15 ppm and the treatment is to be repeated every ten days.

Formalin is also used in combination with malachite green. The mixture contains 0.1 ppm malachite green and 25 ppm formaldehyde. This mixture is good for treating the fish stock maintained in ponds, suffering from the attack of ciliate and mastigophore parasites.

Sodium chloride :

This chemical can be used against all external parasites, excepting myxosporidians of fresh water fishes. It is very much effective against copeped parasites. The only other drug in use against these parasites is water dispersal gammexene. Use of this organo-chlorine chemical is not wise for food fishes as the chemical is poisonous and its cumulative effect on mankind may be dangerous.

Three per cent sodium chloride solution has a direct effect on dislodging *Argulus* from fish body but not the anchor-worms (*Lernaea*) as the head-end of the parasite remains attached with the fish flesh. So repeated bathing may be necessary though one has to be quite careful to do so because the solution can corode the gill epithelia of the fish as well.

5.6 **Copper sulphate ($CuSO_4$)**

Super-saturated solution of copper sulphate has been effectively used to control fungal tail and fin rots of brood fishes when the chemical was applied at the site of infection. The application was done on alternate days, four times in a week for complete cure of the stock.

Copper sulphate is also used to control phyto-plankton bloom. The bloom creates the problem of super-saturation of oxygen at day time and depletion of oxygen at night and early morning. To solve the problem the pond is treated with copper sulphate at a dose of 0.5 ppm.

5.7 **Potassium permanganate ($KMnO_4$)**

This chemical has been found to be effective to control external parasites *viz.* monogenetic trematodes. It is a highly oxidizing agent and the pond is treated with the chemical at a dose of 2 ppm. But the pond has to be treated 4 times in a week. The chemical has a direct effect on the parasites and on the maintenance of the pond-sanitation.

5.8 **Lime (CaO)**

This chemical can control the problem of excessive carbon dioxide in the pond which causes asphyxiation for the fish-stock. To treat the pond a dose of 200 kg. lime for every hectare water body is used. Direct application makes hot spots in the pond and poses a problem of the fish. As such, the chemical is dissolved in water which is sprinkled on the surface of pond water. Then the same is mixed thoroughly with pond water by repeated netting.

5.9 **Acriflavin**

This drug can be effectively used to solve the transport problem of fish seed. When the same is practised, the applicable dose is 4 ppm. This chemical acts well against *Aeromonas* and *Pseudomonas*. As such, it is used for the quarantine of the fish stock.

6. HOW TO CALCULATE THE VOLUME OF WATER IN A POND

6.1 Volume of water in a pond = Length of the pond × Width of the pond × average depth of the pond.

Example : Length 50 meter ; width 20 meter and depth 2 meter ; so the volume of water = $50 \times 20 \times 2$ = 2000 Cu meter.

One cubic meter of water = $100 \times 100 \times 100$ = 1000000 ml (millilitre or cubic centimeter) of water at the normal temperature and pressure.

6.2 How to measure the average depth (column) of water in a pond

The whole surface water of a pond is equally divided into 16 squares by imaginery lines and from each square the depth is measured with the aids of a bamboo pole and a meter-scale. From these 16 figures the average depth (column) of water in the pond can be easily calculated.

6.3 Actual calculation of the volume of water in a pond

Actual volume of water in a pond having slopes can be done as follows :

The surface area : Length 40 meter $\times$ Width 20 meter.

The bottom area : Length 30 meter $\times$ Width 10 meter.

Average depth of water = 1.5 meter.

In such cases the volume of water according to the bottom area is to be calculated first : 30 m $\times$ 10 m $\times$ 1.5 m = 450 cubic meter.

Then the extra volume for the length is to be calculated : 1/2 (40-30) $\times$ 30 $\times$ 1.5 = 5 $\times$ 30 $\times$ 1.5 = 225 cubic meter.

Further the extra volume for the width is to be calculated : 1/2(20-10) $\times$ 10 $\times$ 1.5 5 $\times$ 10 $\times$ 1.5 = 75 cubic meter.

So the total volume of water is : 450 + 225 + 75 = **750 cubic meter.**