Aquaculture Technology

Ornamental fisheries

Elective paper

Ornamental fisheries

Introduction: Ornamental fish culture also known as aquariculture, is the culture of attractive, colorful fishes of peaceful nature in confined aquatic systems. Ornamental fishes are also called as "living jewels".

Ornamental fish production is an important component of the aquaculture industry. The ornamental fish trade is a foreign exchange earner, besides being a source of employment. It has a significant role in the economy of developed and developing countries. The entire ornamental fish industry including accessories and feed are estimated to be worth of more than 14 billion US $ (Thomas, 2008).

Ornamental fish keeping has been serving as a viable recreation, especially for hobbyists from time immemorial. The ancient Romans were the first to keep ornamental fishes as pets at homes. Maintenance of ornamental fish became popular in England and Scotland even in the 18th century. The art of rearing the beautiful fishes by colour, design and shape spread rapidly throughout the world. With the growing interest on the fanciful varieties of brightly coloured organisms, ornamental fish culture developed as a tremendous business. In recent years, this hobby has spread all over the world. As a result, many countries in Asia and Europe started capturing and culturing the colourful, fanciful and the fascinating breeds of the fishes. More and more fishes from the marine, brackish and freshwater environments have been domesticated and popularized for business purposes.

Ornamental fishes are the world's most popular pets and fish keeping happens to be a popular hobby next only to photography. The fantastic shapes and brilliant colours of ornamental fishes won the heart of millions of people; hence, they can be aptly called as "Living Jewels". With more than 120 countries involved in the ornamental fish trade and there are about 1,800 species of ornamental fish in the market of which over 1000 varieties are from freshwater origin, 90 per cent of the fresh water fishes are farmed while 10 per cent are collected from wild.

The E- course on Ornamental Fish Production and Management deals with the culture and breeding of freshwater ornamental fishes. A wide range of aspects such as, construction of aquarium tanks, maintenance of aquarium, important ornamental fishes their breeding, ornamental aquatic plants, preparation of feed and feeding management, water quality management and disease management have been described in detail.

Benefits of ornamental fish keeping as a hobby

- Ornamental fish hobby gives pleasure to young and old people.
- Relaxation to the mind.
- Keep blood pressure at normal level and therefore heart related diseases could be prevented.
- Increases life span.
- Children could acquire new knowledge and skills, by counting the number of fishes in an aquarium they get mathematical knowledge and by observing the behaviour, colour and fin shape of fishes they get scientific knowledge.
- Children could develop sense of attachment with nature.

- Ornamental fish keeping is easy over other pets as they don't make noise and also tank cleaning once in a while is enough (Dog barks, sheds fur and daily cleaning of shed is a must).
- Ornamental fishes like Arowana is believed to bring good luck, wealth and prosperity.
- Ornamental fish keeping can make hobbyists to start their own farms in due course of time thus creates self employment opportunites.

International market

The international market for ornamental fishes is valued at about US $ 5.9 billion. The world export of ornamental fish in 2006 was 282.6 million US $ and imports valued at 308.9 million US $. Around 200 million ornamental fishes are sold every year of which 80% are freshwater and 20% are marine. In freshwater 90% are captive bred and in marine 99% are wild caught. More than 120 countries are involved in ornamental fish trade and there are about 1800 species of ornamental fishes available in the market of which 1000 are freshwater. Guppy is the dominating species followed by Neon tetra.

Major suppliers of freshwater ornamental fish

- Singapore
- Thailand
- Hong kong
- Japan
- Malaysia

Major suppliers of gold fish and koi carp: Israel and Japan.

Major suppliers of marine ornamental fishes

- Indonesia
- Phillippines
- Sri Lanka

Status of ornamental fish farming in India (domestic / national market)

India is still in a marginal position just contributing 1% of total ornamental fish trade. An estimate carried out by Marine Products Exports Development Authority of India shows that there are one million ornamental fish hobbyists in India. The internal trade is estimated to be about 3.26 million US $ and the export trade is about 0.38 million US $ in India. The annual growth rate of ornamental fish trade is 14%. A rich diversity of species and favourable climate, cheap labour make India suitable for ornamental fish culture. Tamilnadu, Kerala and West Bengal are the major states involved in ornamental fish farming. Two categories of ornamental fishes are being marketed from India - exotic and native. The exotic varieties have been marketed domestically and dominating with 99%. Already 288 exotic varieties have been recorded in Indian market. More than 200 species of these freshwater fish are bred in different part of India. Mostly native ornamental fishes are exported. North eastern states, West Bengal, Kerala and Tamilnadu are blessed with highly potential indigenous ornamental fishes. Around 85% of native fishes are from North eastern states. 90% of native ornamental species are collected and reared to meet

export demand. Presently about 100 native fish species have been earmarked as aquarium fish. Kolkata, Mumbai and Chennai are major exporting centres. About 90% of India exports go from Kolkata followed by 8% from Mumbai and 2% from Chennai. Around 4000 peoples involved in this trade including breeding, live food collection, trading and exporting. There are 20 registered exporters.

Commercially important ornamental fishes:

Exotic species

(i)Egg layers

Scientific Name	Common Name
Carassius auratus	Goldfish
Cyprinus carpio var koi	Koi carp
Balantiocheilus melanopterus	Bala shark / Silver shark
Labeo bicolor	Red-Tailed black shark
Rasbora heteromorphy	Rasbora, Harlequin Fish
Paracheirodon axelrodi	Cardinal Tetra
Paracheirodon innesi	Neon Tetra
Colisa lalia	Dwarf gourami
Trichogaster trichopterus	Three spot gourami
Helostoma temmincki	Kissing gourami
Betta splendens	Siamese Fighting Fish
Pterophyllum scalare	Angel fish
Symphysodon discus	Discus / Pompadour fish
Astronotus ocellatus	Oscar
Cichlasoma meeki	Firemouth cichlid
Scleropages formosus	Asian arowana

(ii) Live bearers

Poecilia reticulata	Guppy
Poecillia velifera	Sail fin molly
Poecillia sphenops	Marble molly
Xiphophorus helleri	Sword tail
Xiphophorus maculatus	Platy

Indigenous species

Scientific Name	Common Name
Puntius denisonii	Deninson, S barb
Puntius conchonius	Rosy barb
Colisa chune	Honey gourami
Brachydanio rerio	Zebra fish
Chandra nama	Glass fish
Botia lohachata	Reticulated loach
Notopterus notopterus	Black knife fish
Lebeo calbasu	All black shark
Labeo nandina	Pencil gold labeo
Oreichthys cosuatis	Hi fin barb

Fabrication and setting up of aquariums

A person maintaining ornamental fishes in his house/work place may need only limited equipments and accessories. On the other hand an entrepreneur may need a lot of equipments and accessories to satisfy his customer's needs.

Aquarium can be made of materials like glass, concrete, wood, fiberglass acrylic sheet etc., depending on its location, cost and durability.

Glass tank: They are either all glass tanks or metal framed ones. In the metal (steel or iron) framed tanks glass panels are held in place with putty (battery compound). On the other hand in all glass tanks, glass walls are fitted together edge-to-edge using silicone rubber adhesive. Nowadays, all-glass tanks have completely vanished due to the popularity of metal-framed tanks, which are known for their slim appearance and suitability for keeping marine fishes also.

Shape of aquarium tanks: The shape of the aquarium tank may be circular, square, rectangular, oval, hexagonal or octagonal. However, rectangular tanks are preferred as they provide sufficient area for free swimming of the fishes.

Materials required for construction of tanks

- Silicone gel
- Squeezing gun
- Glass panes (5 no's) with required size

Construction of all glass aquarium glass tanks

These are constructed with only glass sheets. Rectangular all glass tanks are made with a glass wall thickness of 5 – 10 mm. In all glass tanks, the cut glass walls are fitted together with synthetic rubbery sealent called silicone gum. Prior to fabrication of the tank, sidewalls of the tank are arranged so as to have the desired shape. The glass walls are tied with a rope in order to keep the correct shape of the tank. Then the bottom sheet of the tank is kept flat below the arranged sidewalls so as to get the desired and correct shape of the tank. A cut thermocol sheet is kept at the bottom to rest the temporarily tied glass sheets. Now the silicone sealent is evenly applied all along the inner vertical and horizontal cut ends with the help of a hand applicator. Care must be taken to see that the joining ends of the glass pieces are free of oil, moisture or stains. A good sealent compound binds the glass walls in 10 to 20 minutes. However, a curing time of about 10 hrs is required to keep the set tank in position and water should be poured only after 24 hours.

Seating the tank: Soon after curing, the tank is kept on a firm wooden or slotted iron stand. The base of the stand should be even and smooth, as irregular placing of the stands would break the tank bottom. A uniform sized thermocol is also used in between the tank and stand surface to safeguard the tank from pressure.

Setting up of aquarium: Setting up of an aquarium is otherwise called aquascaping. Aquascaping of an aquarium has two purposes.

i) To make the bare tank more attractive for the viewer.

ii) To simualte natural environment by keeping aquatic plants, rocks, gravels, etc.

Choosing a location: The tank should be set up in an attractive and convenient place, which should be free from direct sunlight. Aquarium can be set up in home, hospitals, restaurants, hotels and other public places. The aquarium should stand on a very firm base in order to avoid jerking and toppling.

Steps involved in setting up of aquarium

i) Fitting an under gravel filter: The purpose of the filter is to remove dirty materials from the aquarium. Under gravel filters are otherwise called as biological filters. Toxic substances like ammonia and nitrite are converted to relatively harmless substances like nitrate by the beneficial bacteria developed on the gravel added in the biological filter.

ii) Adding the gravels: Gravels with a particle size of 3-5 mm are used to allow good water circulation and to enable the plants to root.

iii) Installing the air pump; Air pump is installed to operate biological filter for airlifting and aeration.

iv) Adding rocks: Suitable rocks are firmly laid down on the gravel. The rocks are grouped for creating natural look. Several rock pieces can be stuck together with silicone gel to make a cave like structure, which is essential for maintaining cichlid fishes.

v) Filling the tank: Tank can be filled with water through hose pipe directed over a rock in order to avoid displacement of gravels.

vi) Keeping plants: Tall plants are kept at the back and sides. The corners are filled with short species. The roots are buried in the gravel.

vii) Putting the cover glass into position: Cover glass or plastic sheets are used to cover the top. This type has cutouts for cables and for feeding access.

viii) Fitting the electrical wiring: Electrical wiring with respect to light and filters are properly connected.

ix) Setting up the hood and lighting: This is the last stage before introducing the fishes. Fluorescent tubes are used which is fitted inside the hood. The hood may be made of metal, wood or fiberglass sheets.

x) Adding the fishes: Companionable and compatible fishes are introduced in order to avoid fighting between the fishes. The recommended stocking density of fishes in ornamental fish tank is given below. Surface area of the tanks is taken into consideration for calculating stocking density.

- **Tropical freshwater species:** For 1 cm length of fish, 30cm2 surface area is required.
- **Freshwater (Cold water) species:** For 1 cm length of fish, 75cm2 area is required.

Caring the fish:

The newly purchased fishes should not be released into the aquarium tank immediately. The transported polythene bags containing live fishes should be first placed in the tank water so that the water temperature in the bag as well as in the tank water becomes equal. Then the small quantity of tank water may be mixed with that of the polythene bag and this may be kept for about 15 minutes so that the fish would acclimatize to the new water environment. Subsequently the fishes are transferred into the new tank by using hand nets. Immediate feeding of fishes after stocking in the tank should be avoided.

Aquarium accessories and equipments: A person maintaining ornamental fishes in his house/work place may need only limited equipments and accessories. On the other hand an entrepreneur may need a lot of equipments and accessories to satisfy his customer's needs.

Equipments and accessories needed for small scale recreational ornamental fish culture unit

Glass / Fibre Glass Tank: A small tank made of sheetglass/floatglass or transparent fiberglass may be kept in a strong stand made of wood, steel etc. To prevent accumulation of dust particles a hood may be provided. Such hoods will serve as 'lid' for the tank.

Accessories for fish tanks: To beautify aquarium tank, various accessories are used depending on one's taste and affordability. They are as follows :

Hood: Hood or tank cover is made of glass, wood or tin plate.

Stand: To keep aquarium tank in position a stand made of wood or metal is required. It must be capable of carrying the weight of tank

Light Source: Aquarium lights to be fixed inside the hood give bright illumination to the inner environment and help to maintain healthy plants and fishes. Direct and excessive sunlight increases water temperature and development of algal bloom. Lamps may be fluorescent tubes, mercury vapour lamps or metal halide lamps. Lighting for 10 to 15 hours a day is considered sufficient for an aquarium of 5 l capacity a lamp with 10 watt is enough.

Heaters: Heaters are required in cool places where the temperature is less especially during night hours. Heating is most commonly done by using immersion heaters with adjustable thermostat.

Air Pumps and Accessories: In order to keep good water quality in the ornamental tanks and for maintaining the fish in a healthy manner, oxygenation of water is very important. For this purpose, air pumps costing Rs.200 to 500 per piece are available in the market. Air tubes and controlling devices are also needed to regulate the airflow to the system. Air stones are useful for production of small air bubbles and for efficient oxygenation.

Filter: Biofilters and mechanical filters are frequently used to maintain ornamental fish in an aquarium. Some of the filters used in ornamental fish farming include under gravel filter, box filter, poly U filter, power filter, etc. Biofilter can be set up by ornamental fish culturist himself by knowing the principle and by using the easily available raw materials. For institutional establishment and for aquarium maintenance, biofilters coupled with a sump and overhead tank will be of much use. In such flow through systems, a small electric pump (of lesser capacity) will be needed to lift water from sump to overhead tank/filtering units.

Hand Nets: To handle ornamental fishes without subjecting them to injury/diseases, hand nets are very important. Hand nets made of mosquito nets or velon screen or bolting silk are in common use. The brood stock of ornamental fish should normally be handled by hand nets made of velon screen (no.30-40).

Equipment and accessories needed by large scale ornamental fish production unit

If ornamental fishes are mass reared in pond systems, good aeration facilities are very much essential. Various aeration devices are used in aquaculture to oxygenate the water in the culture system. They can be mainly classified as surface aerators, diffuser aerators and turbine aerators. Besides, the water inlet system can also be set up in such a way to facilitate gravity aeration (splash board, race way, transversely corrugated inclined plane etc). Among the various aerators, paddle wheel aerators (a surface aerator type) are readily available in the market at reasonable price (1 HP aerator costs Rs.15,000 to 20,000). Aspirator type aerators are also available in different brand names in global market. For oxygenation of pond bottom, aspirator aerators (air injectors) are efficient. If the depth of the culture system is more than 2m, one can choose aspirator type aerator.

Pumps and pipe lines

For mass rearing of ornamental fishes, the culture system should be free from any weed fish and predator fish. For keeping the weed fish and predator fish at bay, it is advisable to avoid using water from natural water bodies such as rivers, irrigation tanks, reservoirs, etc. Underground water with good quality especially from rich aquifers is always preferable. In the above background, quality pumps are highly essential. In order to maintain good water quality, water exchange may be needed under high density stocking. In such cases, to carryout periodic flushing and emergency irrigation, pumps assume priority.

Equipment and accessories for large scale ornamental fish seed production

To bring brood stock of fish from far off places to the farm, fish transportation tins are needed. In addition to brood stock, transportation of ornamental fish seeds also needs certain common accessories. Polythene bags are needed for fish transport. An oxygen cylinder with a pressure gauge is highly essential for oxygenating the water kept in the transportation tin and polythene bags. To make the eggs hatchout, hapas made of gada cloth/bolting silk/velon screen are also essential.

Food/feed production units

For the production of live food organisms, cement tanks and FRP tanks of assorted size will be beneficial. To prepare fish feed pellets, mixers, grinders, steaming devices, pelletizers, driers, etc., are needed in commercial ornamental fish farms. To produce pure algal culture (single cell food needed for baby ornamental fish), algal culture units with air conditioned facilities, illumination system, containers, autoclave etc, may be needed in large scale intensive aquarifarm.

Aeration and filtration

Aeration: Aquarium fish like other fish breathe in water by means of gills, using oxygen dissolved in water. A certain minimum level of dissolved oxygen in water (normoxic condition) is essential for their survival. For a number of reasons, the water may have oxygen level critically depleted, endangering fish. The confined water of the aquarium is more prone to risk of depletion in level of dissolved oxygen (hypoxic condition). To offset the risk, it is necessary to provide additional means of aeration of water

because oxygen of atmospheric air diffuses only slowly into water at the interface between it and air (the surface of water). Aeration achieves fast oxygen optimization in the following manner:

(a) a stream of air-bubbles, when forced through a column of water, provides enhanced interface area between air and water; smaller the bubbles better is aeration.

(b) water when sprayed like a fountain head (broken into tiny parts or drops) has increased surface area at the interface with air, achieving efficient aeration.

(c) a turbulence produced in water due to rising air bubbles as they break at the surface greatly increases the surface area of water at the interface with air.

(d) a movement of water (air driven or pump driven) speeds up circulation of dissolved oxygen (which in still water is a very slow process) as it spreads from surface down to bottom by diffusion.

Aeration is accomplished by any one of the following ways, singly or in combination:

(i) Air is bubbled through the column of water using an aerator (air pump) and an air stone (diffuser). This combines the three processes stated above.

(ii) Pumping water out of the aquarium tank (as during filtration) and returning it directly into the tank water or spraying it over its surface using spray-bar. In this case processes b and d are involved.

In a small aquarium (home aquarium), agitation of water produced by air-bubbling is more important for oxygenation than air-bubbling itself. The fact is that a bubble takes only a few seconds to rise to surface and burst there. Such a short time of exposure to water does not permit much oxygen diffusion from air to water as it is a slow process. Use of an air stone increases chance of oxygenation as air is broken down into very fine numerous air bubbles. However, air-bubbling is instrumental in oxygenation of water rather indirectly. The agitation and turbulence produces circulation of water – an unending renewal of surface water (most oxygenated) by less oxygenated or oxygen depleted water brought from below with rising stream of air bubbles. The main oxygenation of water takes place at water-air interface at the surface.

Aeration, on the one hand, increase dissolved oxygen concentration in water and, on the other hand, removes equally fast free carbon-di-oxide from it. It also helps in preventing “cold spots” in the aquarium tank which otherwise may develop in still water of large tanks. Aeration should be looked upon not as a substitute for management but a mere part of it.

Aerators:

Aerator is an air-pumping device which is electrically operated. The device consists of a vibratory air pump – a tiny rubber diaphragm. When alternating current (A.C) passes a shaft bearing a magnet vibrates briskly under a magnetic field effect. As the shaft is attached to the diaphragm, the latter is allowed to vibrate up and down like a piston, producing a forceful stream of air. The air flow is then directed into the bed of the aquarium tank using plastic air tubing (thin pipe). At the opening, a diffuser (air stone) may be used to produce tiny bubbles of air. The aerator is a very useful handy device for

small home aquarium. They are cheap, long lasting and need little maintenance. However, there are a number of drawbacks too. First, they produce an unpleasant, rather loud, humming sound. Second, they are ineffective in large and deep tank. It must be noted that an aerator does not generate fresh air. On the contrary, it only pumps out into the tubing the air of the surrounding. An aerator is likely to drive any fumes, chemical vapours and so forth alongwith the air into the aquarium tank which may prove harmful to fish. It should therefore not be operated if any such situation exists in the room.

Apart from its role in aeration of tank water, aerator has a role of air-lifting of water for filtration. In undergravel filter, an aerator is used to confine the rising stream of air-bubbles into a narrow vertical tube (the uplift pipe) to bring about air-lifting of water and any suspended particles in it.

Power air-pump:

To produce aeration in large and deep aquarium or a battery of aquaria, such as those installed in public aquaria, more powerful electric motor driven piston-pumps or rotary pumps are used. They are more efficient due to high output and noiseless running. However, they are expensive and need care and maintenance more frequently.

Spray bar

The outlet of power filter is fitted with a spray bar to enhance aeration of water as the filtered water is returned to the aquarium tank. The spray bar is a perforated tube which produces a rain of small droplets of water falling on the surface of tank water. The agitation of water produced at the surface by falling water drops helps in better oxygen diffusion at air-water interface.

Filtration: Filtration of aquarium water is an essential element of water management. The process serves two purposes:

1. Maintenance of good water quality.

2. Partial correction (within certain limits) when the water goes wrong.

Good quality of water means a water that ensures a proper environment for fish to “drink”, “breathe”, “move” and even “pass metabolites” (excreta, urine and carbon-di-oxide) into it without becoming harmful to fish’s health and well-being. A water is said to be of good quality when its contents (chemicals, dissolved gases, organic matter) or condition (temperature and turbulence) are in a state which is good for fish, and is free from undesirable suspended particles and pollution. Pollution may arise from intrinsic (developing within the aquarium) or extrinsic (accidentally introduced) factors and will make the water wrong, weakly harmful or lethal to fish. Even a very well planned and properly stocked aquarium will need filtration in the long run.

In a filtration process the aquarium water is allowed to pass through a filter medium to cleanse it and is finally returned to it. Filtration is done basically in three ways:

(a) Mechanical filtration : Solid suspended particles are trapped and filtered out just mechanically.

(b) Chemical filtration: Harmful soluble chemical contents of water as those which alter its pH, impart it hardness or fish's metabolites are rendered harmless by changing their chemical composition chemically.

(c) Biological filtration: Conversion of ammonia and nitrite which are highly toxic into non-toxic nitrates is done biologically by using a population of bacteria to feed upon the excretory products and similar detritus wastes.

Except the chemical filtration, mechanical and biological filtration combine in any filter eventually. All the three kinds of filtration process may be incorporated in a single filter. Accordingly, in a filter one or more filter media are used.

One has to be prudent in deciding which filtration to choose for a given aquarium. A number of factors need to be considered such as size, effective water volume and movement / turbulence and metabolic loading due to fish / other animals (stocking density and feeding and locomotory habit). On the other hand, it is also important to monitor filtration efficiency (filter volume and turnover rate) of the filter used in the aquarium which may be done by estimating the concentration of ammonia (NH_3), nitrites (NO_2) and nitrates (NO_3).

Filtration also helps in aeration by circulating the water of the tank irrespective of whether water is power driven or air-driven.

Filter media

A number of filter media are available. The more common ones are given in Table.

Filter media

Sl.No.	Filter Medium	Working	Items removed
1.	Nylon floss	Mechanical	Solid suspended particles
2.	Filter (glass) wool	do	do
3.	Plastic foam	do	do
4.	Sand	do	do
5.	Gravel	do	do
6.	Diatomite (diatomaceous earth)	do	do
7.	Sponge	do	do
8.	Diatom Skeleton	do	do
9.	Activated charcoal	Chemical	(CO_2, pH & hardness)
10.	Limestone chips	do	(pH & hardness)
11.	Coral sand	do	do
12.	Peat	do	do
13.	Resin (zeolite)	do	Hardness & NH_3

Infact, all media work mechanically, and biologically if left undisturbed over long period. In the latter case, all media will be eventually colonized by bacteria. Plastic, glass and gravel may offer good bed (surface area) for bacteria to grow on.

Of all the filter media, the cheapest are floss, foam and gravel. Peat, on the other hand, is not long lasting and needs replacement at quick intervals (as it is quickly exhausted).

Filters

Conventional filters are usually designed on two working-principles:

A. Aquarium water is siphoned into filter unit where it is allowed to slowly pass through one or more filter media before being pumped up or air-lifted and returned to the aquarium tank.

B. Aquarium water is allowed to pass through the substrate at the bottom in a continuous circulation which is maintained either by air-lifting or by power head.

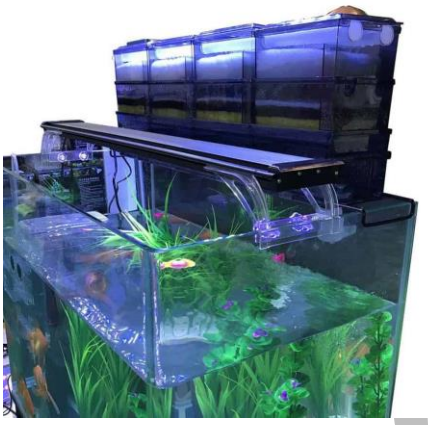
Most filters combine filtration with aeration (for optimizing dissolved oxygen concentration of aquarium water). Various measures are taken for aeration.

Canister filter (external or internal type)

It is a self-contained unit comprising of a container, provided with an aerator or an electric pump. It operates on principle 'A' described above. It may be situated inside or outside the aquarium. The external types have inlet and outlet pipes while the internal types are provided with slits for the purpose. The filter media used include nylon floss, glass wool, foam, activated charcoal, resin etc. It may be used for mechanical, biological and / or chemical (optional) filtration by combining it with a sub-gravel filter. It is used for both freshwater (air-lifting type) and marine aquarium (power lifting type). The power driven type can remove all solid debris and maintains a constant forceful circulation of water dislodging food particles trapped in gravel or corals.

Trickle filter

It is a modified version of external canister filter. A stack of several trays with perforated bottoms are placed above the aquarium and used in conjunction with an external canister filter. The aquarium water after initial filtration in the canister filter is sprayed into the top tray from where it trickles from one tray to the other and is finally returned to the aquarium. The trays are part-filled with filter media and thus reinforce filtration. The main advantage of the trays atmospheric oxygen. Optimization of oxygen uptake of water results in enhanced bacterial activity.



Trickling filter

Submersible power filter (box filter / corner filter)

It is a very compact filter that works under submerged condition at any depth of water. The plastic box sits at the gravel bottom in a corner. It is very suitable for small aquarium in which metabolic loading is less. A flow of water is continually maintained in and out of the filter unit. The flow is driven by a powerhead. The aquarium water is drawn in through a slit in an outer chamber and then passed through a sponge / foam, held against a sieve, and finally driven out of the unit to be returned to the aquarium. The box filter silently works to carry out mechanical and biological filtration. It will need to be supplemented with chemical filtration, if necessary. The outer chamber is so designed as to trap detritus "dirt" in a partitioned portion from where it can not escape. Filter, however, needs periodical cleaning. The powerhead also needs maintenance; the impeller attached to the pump shaft needs periodical cleaning.

It is generally used for freshwater aquarium only.

Submersible power filter

Submersible air-lifting filter (inside filter / corner filter)

The submersible filter is rather compact. It is attached to the aquarium wall on the inside in a corner by means of a sucker. It works on the principle of bubble-air-lifting of filtered water, which is produced at the air stone fed by an aerator pump. A foam filter is used. Obviously, the filter combines filtration with aeration. Aeration takes place during the bubble-airlifting as well as the outlet where water is returned to the aquarium in the form of a spray.

Submersible air-lifting filter

Water quality management: Water is the prerequisite for the maintenance, breeding and culture of tropical ornamental fishes. For ornamental fish farming water is mainly obtained from rain, river, artesian well, canal and reservoir. The physico-chemical characteristics of water such as pH, hardness, temperature, dissolved oxygen; chlorine and carbondioxide content play a key role in the breeding and production of many ornamental fish species.

pH: The pH of water usable for ornamental fish farming may vary from acidic to alkaline depending upon its source, chemical and biological factors. Marshy and peaty water has acidic pH. Similarly, water springing from a soil poor in calcium will have acidic pH.. Some ornamental fishes such as oscar and discus will spawn only in slightly acidic pH and soft water. To this, various makes of water softeners are used and inorganic acids, for example, hydrochloric acid can be used. If the pH of the water falls below the desired value, it must be increased by the addition of required doses of calcium hydroxide (slaked lime). The optimal pH for the growth and breeding of majority of the ornamental fishes should be neutral or slightly alkaline i.e. 7-8. Water in ornamental fish tanks should never fall below 5 or rise above 8.5. Ornamental fishes preferring slightly acidic pH (6.2-7) include rosy barb, tiger barb, tetra, angel and danio. On the other hand, certain fishes like cichlids, goldfish, koi and gourami prefer alkaline pH.

Chlorine: Ornamental fish culturists in cities often have water quality problem as the tap water used by them contains chlorine beyond permissible level. The growth and survival of any sensitive fish are affected by chlorinated tap waters. Chlorine content as low as 0.1.ppm itself is toxic to fishes. The chlorine content of such waters can be dechlorinated by heating the water.. Alternatively water with chlorine will have to be kept over night where the chlorine escapes and the water becomes usable.

Water hardness: It is nothing but the total soluble calcium and magnesium salts present in the water expressed as its calcium carbonate equivalent. The total hardness of water however, includes the sulphates and chlorides of calcium and magnesium. The total hardness is mainly used to classify waters into 'hard water' or 'soft water'. Water with hardness of 100-300 ppm have been found to be optimal for the normal growth of majority of ornamental fish. Water with less than 12 ppm require liming for higher production of fish. Hard water is also known to influence feed intake and growth of cichlids such as angel, black zebra, firemouth, blue morph and auratus.

Carbondioxide: Free carbondioxide at a concentration of more than 15 ppm is detrimental to ornamental fishes.

Temperature: Water temperature is one of the most important factors influencing the breeding, rearing and transport of tropical fishes. Although majority of the ornamental fishes tolerate water temperatures between 21 and 30oC, 28oC, have been found to be most suitable for the breeding of tropical ornamental fishes. In order to maintain optimal temperatures, suitable devices have to be used.

Oxygen: Dissolved oxygen content of the water plays a crucial role in fish culture. Fishes of aquarium tank would be under stress and be liable for parasitic attack if optimal oxygen levels are not maintained. The solubility of oxygen in water depends on its temperature and also on the rate at which it is kept in contact with water. Oxygen dissolved in water by direct diffusion at the air-water interface. Further, it is also made available by the presence of aquatic plants. The oxygen level of aquarium tanks can be enhanced by constant aeration, circulation of water, sprinkling of water, surface agitation, etc.

OPTIMUM LEVEL OF WATER QUALITY PARAMETERS REQUIRED FOR ORNAMENTAL FISH CULTURE

Factors	Optimum Level
Temperature	24-280C
Oxygen	More than 5ppm
pH	7-8
Hardness	150-200ppm
Ammonia	Trace
Nitrite	Trace
CO2	less than 1ppm

Aquarium plants

- Aquarium plants give natural look to aquarium.
- They provide food for fishes. Herbivorous fishes directly eat the plants. Other fishes eat the organisms attached on the leaves.
- They provide shelter, shade and hiding place for smaller fishes.
- They serve as spawning site for certain fishes.
- Plants and fishes have symbiotic relationship. The fish waste is used as an excellent fertilizer for plants. Plants in turn remove nitrate and CO2 from water.
- Plants are best filters and thus help to maintain water quality.
- Some of the plants are believed to reduce pH of water which is suitable for breeding of certain fishes like tetra, angel etc.

Types of plants

1. Floating plants : Plants have their foliage (leaves) above the surface of water with roots hanging free. Ex. Eicchornia, Pistia, Spirodela, Lemna, Azolla, Wolffia, Salvinia, Riccia sp.

2. Emergent plants : Plants having their leaves and flowers above the water surface but rooted in the bottom. Ex. Nymphaea, Nelumbo, Nymphoides.

3. Submerged plants : Leaves are submerged in the water, may or may not be rooted. Ex. Hydrilla, Ceratophylum, Myriophylum, Ottelia, Bacopa, Ludwigia, Saggitaria, Aponogeton, Cabomba, Limnophila, Ceratopteris.

Rooted plants : Hydrilla, Najas, Ottelia, Vallisneria, Potomogeton, Lagarosiphon, Chara, Nitella.

Devoid of roots : Ceratophyllum, Utricularia.

4. Marginal plants : They are growing in the shallow areas of the water body (near shore). Ex. Typha, Cyperus, Ipomea, Eleocharis, Cryptocoryne, Echinodorus.

Important aquarium plants

1. Lemna minor : Commonly called as duck weed. Minute (tiny) free floating aquatic weed. The roots are minute. It is a good source of feed for vegetarian fish and ducks. It is capable of purifying waste water. It spreads spontaneously at an amazing speed. It will cover the entire surface of the tank if unchecked.

2. Hydrilla sp. : Submerged weed. It grows under water. But some of their leaves are coming out of water. Usually they are anchored to the hydrosoil. However, it may get completely detached from hydrosoil and continue to grow as free floating near the water surface. The stalks are upto 3 m long. It bears whorls of 2-9 straight dark green leaves at short intervals. The leaves are 2 cm long, and 0.3 cm wide. It is easy to grow either it's rooted or free floating form provided it is given good light.

3. Najas minor : Submerged aquatic plant. Plants are 20-30 cm long. Stems are thin. Narrow leaves of 1-2 cm in length. The leaves are green in colour. Sickle-shaped, 6-10 pairs of teeth. It lives in shallow,

stagnant waters. The Najas is easy to grow. It requires good light and clear water. It can thrive and grow as free floating.

4. Marsilia quadrifolia : Common Name : Four leaved water clover, clover fern

Family : Marsiliaceae Shoreline weeds.

Found in shallow waters. It has thin rhizoids anchored at the bottom. It has long filamentous stems each ends with a cluster of four oval shaped leaves.

5. Vallisneria sp. : Family : Hydrocharitaceae

Common Name : Tape-grass, eel grass, ribbon grass.

Submerged aquatic plant. It anchors to the hydrosoil. It is a most common aquarium plant. They need bright light, but grow slowly in dim light. Ribbon like green leaved tall plant. The leaves are 30-80 cm long and 0.4 – 0.8 cm broad.

6. Ipomoea aquatic : Common Name : Water spinach

It is a common aquatic plant in India. This is used for human consumption. Found in shallow waters. It grows in shore, when water is filled in that area it detaches and become free floating. Hollow stems with white spongy floats and rooting at nodes. Leaves are elliptic or ovate-oblong. Flowers are white or pink.

7. Ceratophyllum (Horn wort) : Family : Ceratophyllaceae

Submerged, rootless, free swimming plants. Consist of long stems bearing side branches. Leaves are short, thin spikes, sharp and harsh to touch. Darkish green colour leaves. Stems bear whorls of at most 10 leaves growing at a slightly upward angle. Each leaf with 2-4 leaflets, forked and spiky reminiscent of a pair of horns.

8. Nymphaea sp. (water lily) : Family : Nymphaeaceae

It has roundish or oval shaped leaves floating at the water surface. Bears long stems. Attached to bottom mud rhizoid roots. Flowers are very large. White or coloured. They have a delicate scent and float at the surface (N.nouchali). N. stellata is another lily. The leaves are submerged with serrated edges. Smaller than N.nouchali. It bears small light blue flowers, purple or pink.

9. Eichhornia crassipes (water hyacinth) : Floating plant has a rosette of large round leaves and swollen stalks that give the plants its buoyancy. It has hanging roots. Most abundantly growing water plant. The plant can multiple at a phenomenal rate of 15% surface area per day.

10. Cabomba sp. : Family : Nympheaceae

Submerged plant. Plant has stems upto 150-200 cm long. Fan shaped leaves grow opposite each other at regular intervals. Leaves are beautiful, light green. It grows easily. Good light is required. It is easy to propagate by top cuttings.

11. Echinodorus sp. : Family : Alismataceae

Submerged plant. Commonly called Amazon sword plant. The leaves are arranged in a rosette growing out of rhizome. The leaves vary in shape. They are elongated lance-shaped, oval shaped (or) heart shaped. The leaves are 20-40 cm long and 2-4 cm wide. Light green colour.

12. Salvinia : Family : Salvinaceae

Stalk lies horizontally just below the surface and bears whorls of three leaves. Two of which float on the surface. They are oval shaped. The third leaf hangs down freely in the water (which is transformed into feathery branch similar to little roots hanging below the water). The surface of the leaf is rough with short stiff bristles.

Other important aquatic plants and their common names

Aponogeton fenestralis - Lace plant

Pistia sp. - Water lettuce

Ceratopteris thalictroides - Indian fern (or) water sprite

Crypotocoryne willisini - Hidden club

Limnophila sessiliflora - Ambulia

Myriophyllum - Milfoil

Sagittaria sagitaefolia - Arrow weed

Eleocharis acicularis - Hair grass or needle grass

Feed and feeding management

Proper feeding of aquarium fish requires patience. It is important to understand the different species, and their life cycles. The amount of food required depends upon the type of food, culture conditions, and individual fish. Newly hatched larvae may feed almost continuously. Fish generally will not overeat, unless they are fed too infrequently. One to two feedings a day are best for most fish. More for newly hatched fish and less often for larger fish.

Most problems with overfeeding result when wasted food spoils the quality of water in fish tank. Ammonia and other products of decay will degrade water quality and stimulate disease organisms. In the aquarium with under gravel filters, it is common for the under gravel to clog from accumulated uneaten food and debris. This problem can be eliminated with frequent aquarium care, including water changes, redistributing the aquarium decorations, and cleaning external filters. Common bottom-feeding fish such as loaches, plecostomus, and catfish can also help to keep the aquarium clean.

Live food organisms

A number of live foods can be used to add colour and to condition the fish for breeding. Feeding a restricted range of live foods, and exclusion of all other kinds of foods, is unlikely to provide a balanced diet, and may even lead to nutritional or other internal disorders for the fish. As many live foods originate from ponds, streams or rivers, they may bring with them aquarium pests, such as hydra, snails, or disease causing organisms. The risk of introducing disease organisms can be reduced by collecting live foods from fish free water, but the possibility of introducing aquarium pests still remains. It may be safer to use live foods disinfected before use.

Earthworms are an excellent, live food for all kinds of fish, including goldfish. Anyone, who has access to a garden or patch of waste ground should be able to collect enough for their fish. After collection, the earthworms must be kept for a few days in a sealed container. This should have small air holes. During this time the worms will clean themselves of solid and wastes and will then be more palatable for the fish. The worms can be given as whole or chopped, depending on their size and the size of the fish.

Sludge worms, such as Tubifex and other tubificid worms, are a live food familiar to most tropical fish hobbyists. These slim, centimeter-long, maroon worms are often used to tempt fish such as Discus to feed, and are given as a live food to adult breeding fish. Tubifex worms are not easy to culture successfully and so are most often obtained from an aquatic shop. Unfortunately, in nature these worms live in polluted stretches of rivers and streams, and it is from these unsavoury sources that most Tubifex are collected for aquarium use. Therefore, tubifex should be used sparingly in the aquarium only as an occasional food rather than as a staple diet. Before use, the worms should be rinsed gently in cold running tap water for several hours. Once cleaned, Tubifex worms live for some time in a shallow dish of cold water.

Water fleas are tiny planktonic crustaceans, such as Daphnia and Cyclops. Like tubifex, they are a popular live food among tropical aquarists. This is suitable for larger fish fry or to condition adult fish for spawning. However, like Tubifex, using water fleas as a live food may result in the introduction of unwanted pests or disease causing organisms. Unfortunately, Daphnia and related forms are less easily disinfected than Tubifex, ideally therefore they should be obtained from a safe fish-free pond.

Bloodworms are the aquatic larval stage of a two-winged fly. Difficult to culture, they are best obtained from aquatic shops and are particularly useful in the winter months, when other live foods may be scarce.

In egg laying fish species, nutrients trapped in the egg sac would be normally sufficient to the hatchlings. Afterwards, the tender hatchlings are fed with green water consisting of microscopic algal species of Protococcus, Tetrosphaerium, Chalmydomonas, Chlorella, Volvox, Eudorina, Pandorina, etc. Certain filamentous algal species of Spirogyra are known to serve as an ideal food source for the fry and juvenile fishes. The above green water is a viable food source especially during the first two weeks of growth.

Aquarium fish, depending on their feeding habits and preference may be fed with live foods. Such as mosquito larvae, fruit flies, bloodworms, tubifecids, Cyclops, daphnids, rotifers, brine shrimps

earthworms white worm and microworm or with moist pellets, dry pellets, flakes and chopped bits of fish, shrimp, beef, oyster, crab and liver, spleen, lung, heart and brain of cattle.

Feeding of young ones (fry): Fish fry require smallest size of food. Generally fry of live bearers are bigger than that of egg layers. Live bearers fry eat food items immediately after release from the parents. In the case of egg layer, after hatching the fry takes yolk as food from its throat region. They search food only after 3 to 5 days when they become free swimming.

Feeds of fry: Oxbow theory Feeds of fry

The fry immediately after they become free swimming can be fed with either of the following items or all the items alternatively.

1. Green water – Green water is collected from pools or ponds or tanks. Small containers are used to produce green water. Scrapings of green algae are inoculated and urea and super phosphate are added as fertilzier. After 5 days, the green water is ready to feed the fry.

2. Infusoria – Infusoria can be either cultured or collected and fed to fry.

3. Baker's yeast suspension – Yeast is dissolved in water and this milky liquid is used as food.

4. Egg yolk suspension – Yolk of boiled egg is dissolved in the fry tank through bolting silk cloth.

In case of feeding with egg yolk, water exchange should be done every day to remove excess food to avoid bad smell and mortality of young one.

Feeding frequency: The above feeds are continued for 7 to 10 days. In case of cichlid fry and live bearers fry, the above food items can be skipped and directly the following food items can be given as their size are comparatively bigger. Early hatched (immediately after hatching) daphnia and artemia nauplii can be given. Finely ground formulated feeds can be given to live bearers fry immediately after their birth for 10 – 15 days. The following food items can be given after 25 to 30 days of birth -Daphnia, blood worms, earth worms, tubifex, mosquito larvae, artemia and formulated feeds.

Collection and culture of Infusoria:

Collection : Infusoria belong to the class Ciliata under the phylum Protozoa. They serve ideally as starter feed for early stages of ornamental fishes. The tiny microscopic one celled animalcules like Paramaecium are collectively called Infusoria. They are found in ponds, tanks and ditches. They can be easily collected with 0.13 mm mesh cloth.

Culture of Infusoria : By using Banana peelings, cabbage, potato, hay, lettuce leaves :

Any one of the above material is kept in a container filled with water. The container is covered to prevent the entry of mosquitoes but air should be allowed. The container is kept in a cool place. In two days the water will turn milky and have foul smell. This is due to the multiplication of bacteria which decay the material. A film of slime will be formed on the water surface. In about 4 or 5 days the water will turn clear, with light yellow colour. This is because of the floating spores of Infusoria in the air which

have settled in the water and are feeding upon the bacteria and multiply. Subsequently the film of slime on the water surface will break up and disintegrate. The culture is now ready for feeding the early stage of fish larve. The culture will continue to flourish for 2 to 3 weeks if a few drops of milk are added.

Culture of daphnia

Daphnia are commonly called as water fleas. They are cladocerons. Daphnia inhabits in freshwater ponds and tanks. It feeds on algae, bacteria etc.

Natural collection : Daphnia can be collected from pools, ditches and any stagnant water bodies. They swims on the water surface before sun rise and after sun rise they go to bottom. Hence Daphnia should be collected during early morning hours. Daphnia can be collected with the help of a scoop net having 100-200 micron mesh.

a) Stock and pure culture:

Daphnia can be cultured in mass scale level. To prepare stock and pure culture daphnia should be collected and the sample has to be diluted and taken in a glass beaker. Individual Daphnia is picked with the help of a dropper and placed one in each tube containing 10 ml of filtered freshwater. Daphnia is fed with yeast or groundnut oil cake at 200 ppm daily. These tube cultures are transferred to 1 litre jar and feeding is continued. After 5-6 days, the jar culture is inoculated in mass culture tanks.

b) Mass culture:

Depending on the requirements, Daphnia is cultured in 500 to 20,000 litre capacity cement or plastic tanks. The culture tanks is thoroughly cleaned and filled with filtered freshwater. Before starting a mass culture, medium is prepared as follows :

Medium preparation :

Slurry is prepared by adding 10 kg of chicken droppings, 5 kg of groundnut oil cake and 2.5 kg of single super phosphate in 250 litre freshwater. Continous aeration is given for 3 days for the escape of obnoxious gases, fermentation and release of nutrients. After 3 days the slurry is used as fertilization solution in the mass culture tanks. In the mass culture tanks, the medium is added at 3 to 4 ml per litre of water regularly for 3 to 4 days. On 4th day, Daphnia is inoculated at 50 individuals per litre. In about 7 days, Daphnia multiplies and density reaches from 10,000 to 25,000 individuals per litre. The Daphnia is harvested using 100-200 micron mesh scoop net in the early morning or late evening when they are on water surface. The Daphnia is washed thoroughly and fed to fish fry.

Moina culture and Brachionus culture :

Culture of monia and brachionus are similar as that of Daphnia culture. Inoculation is done with respective live foods.

Culture of tubifex:

Tubifex comes under the phylum Annelida. Tubifex are small, reddish worms up to 2 cm long which occur in the mud of ditches and streams. Their front portion is inside the mud for taking food and posterior end is above the mud for respiration. Tubifex worms form an ideal food for faster growth and reproduction of ornamental fishes.

Natural collection :

They can be collected from ditches and canals. The mud along with tubifex is collected and kept in a large bucket for drying of water. During drying, the worms will congregate to the surface due to lack of oxygen. Then, they are collected and washed to remove the residual mud attached to the body. But their guts still may contain mud which they have eaten and should be kept under the stream of water for the mud to be evacuated from the intestine. After proper cleaning, they are fed to fishes.

Method – 1 :

Cement tank can be used. Mud from ponds or canals is kept upto 5 cm. Water is filled to 5 cm depth. Rice bran is spread over the surface and left to ferment for 3 days. After 3 days the Tubifex worms are inoculated. Care must be taken not to let the pond mud dry completely. After one month the pond can be refilled with water up to 4 to 6 inches aboue the mud. After the filling the worms will congregate on the mud surface where they can be easily harvested. The cycle can be repeated after three days.

Method – 2 :

It can be cultured in any container with 5 cm thick pond mud on the bottom mixed with decaying vegetable matter and rice bran and bread. Continuous mild water flow is to be maintained in the container with a suitable drainage system. Then Tubifex worms are inoculated. Within 15 days, clusters of Tubifex worms develop.

Culture of blood worms:

Blood worms are otherwise called as Chironomus larvae. The intermediate larval stage of the midge fly is commonly called blood worms. They belong to the family Chironomidae of the phylum Arthropoda. They are usually red in colour. It is one of the best live food items for ornamental fishes.

Culture : Flat trays are used as container. Water is filled and then soil and compost cattle manure is added to attract the chironomous flies to deposit eggs. Each female lay about 20000 eggs which hatch out about 3 days. The larvae are harvested and washed thoroughly and kept for conditioning to evacuate the gut contents before feeding to the fish.

Live food feeders

Worm feeder: When feeding with live food like Tubifex care should be taken. By dropping tubifex, the worms go to the bottom and burrow in to the substratum before the surface and mid water fish get at them. In order to facilitate the feeding for the surface and mid water fishes, worm feeder is used. Worm

feeder is a plastic conical device perforated with minute holes. This device is attached on the sides of the glass tank. The worms are introduced into the feeder and worms wriggle free of the holes. Thus allowing fish plenty of time to eat.

Types of feeds

i. Dry feed – 8 – 10 % moisture – Further classified into five categories :

a). Pellets – Sinking or floating

b). Flakes – Flat in shape. It floats at first and then sinks slowly. It is available in different colours.

c). Freeze dried feed – kept for longer time without degradation of nutritional value. These are available in cubes which adhere to glass tank. Fishes nibble at it as it dissolves.

d). Tablet form – It can be stuck at different water levels.

e). Granular or crumble feed – small particles suitable for larvae.

ii. Moist feed : It can be prepared daily and fed to fishes.The moisture content of the feed is 35%. It can not be kept longer periods due to their high moisture content.

iii. Semi-moist / paste feed : For baby fishes, this can be given by squeezing through mesh.

Breeding of live bearers

Livebearers are fish that bear live youngones. There are two types of livebearers: ovoviviparous, where the eggs form and hatch within the female before birth; and viviparous, where no eggs are formed, and the young are nourished through an umbilical-like cord or from secretion by the female. Livebearers are generally prolific and are easily bred.

The important live bearers are guppy, molly, swordtail and platy.

Maturity: Usually live bearers mature between 4 and 6 months. However, guppy and platy may mature even within two months.

Sex identification:

- Male
- Female
- Smaller
- Larger
- Brightly coloured and attractive
- Dull coloured
- Fins especially dorsal and caudal fins are longer
- Comparatively smaller
- Belly region is flat

- Belly region is bulged
- Anal fin is modified into gonopodium which is a rod or tube like structure
- Anal fin is normal in shape.

Conditioning of parent fish

Before placing the parent fishes together for spawning, they should first be conditioned. Conditioning is feeding the fish with a variety of healthy foods to make them attain suitable condition for spawning. Many species may be conditioned using a well-balanced flake food, though others may be conditioned with live foods such as brine shrimp, insect larvae, and earth worms. The parent fishes should be separated while conditioning. Such fishes when reintroduced, will ready to spawn.

Breeding of live bearers : In live bearing fish, the eggs are situated in the egg duct where they are fertilized. Upon hatching, the fry are not immediately delivered, but they remain in the safety of the mother's body until they reach a stage of development equivalent to the young of egg layers that have absorbed the yolk sac and become free swimming. The ideal temperature must be 27oC.

As the male matures, the anal fin becomes more pointed and straightened into a rigid tube like projection, which is called gonopodium. The gonopodium is carried normally close to the body and pointing rearwards. However, it is a mobile organ and can be angled in almost any direction. The males court the females with their fins erect and they chase the female untill the opportunity presents itself for a lightening thrust of the gonopodium. The female is fertilized by the nearest touch of the gonopodium on her vent, and one fertilization will last for several broods. Unlike the male, the female has normal analfin. Females can have upto eight broods from one fertilization therefore it is unnecessary to remate after the first brood. The period of gestation is being constant for every species.

Females about to give birth are said to be ripe. This condition can be determined by the appearance of the dark, crescent shaped area in the female body close to the vent known as the gravid spot, which is accompanied by a general fattening of the belly when viewed from above. The eggs develop and actually hatch out inside the mother and leave her body as fully developed fish. The number of young in a brood is largely dependent upon the size of the female. Irrespective of the number in the brood the fry are approximately all the same size at birth. Livebearers are notorious cannibals; they will devour their youngones as soon as they are born. This can be prevented by having an abundance of cover for the youngones in the form of bunched fine leaved plants, or to use a breeding trap, which restricts the female to a small part of the aquarium, but allows the fry to escape into the wider reacher of the breeding tank.

The preparation for the breeding tank is simple. It need not be too large for most species, and should be filled to a depth of about 8" (20cm) with matured water and the temperature is raised to about 25oC. The tank should be well stocked with fine leaved plants. Once the female has given birth to the full brood she can be removed. Instead of plants, nylon knitting wools can also be used. Handling livebearers when they are near the time to delivery can cause premature birth. Premature babies have not completely absorbed their yolk sac, which can be seen attached to their bellies. Livebearers normally kept in a community aquarium tank will breed indiscriminately, and will often crossbreed between

similar species. If the aquarist is interested in obtaining a particular colour strain or any other feature for that matter it is imperative that the sexes are housed separately.

Number of young ones:

The number of young ones i.e. brood varies from fish to fish and also it depends on the size, feed given and tank environment. In an average 20-40 young ones can be expected.

- Guppy maximum 100 numbers
- Platy maximum 50 numbers
- Molly maximum 100 numbers
- Swordtail maximum 200 numbers.

After 2-3 days the female again becomes pregnant even without the contact of male. The sperm transferred during first mating is stored in the female body and when eggs are formed the sperm will join with eggs and form young ones. Thus by single mating youngones can be released 8-10 times. In an year it is possible to get young ones 10 times from one female.

Feeding of fry: Baby fish i.e fry can swim and eat from the moment they are born. It accepts infusoria,finely crushed dried food, brine shrimp naupli, etc.,

Breeding of egg layers

The majority of aquarium fish are egg-layers with external fertilization. Egg-layers can be divided into five groups: egg-scatterers, egg-depositors, egg-burriers, mouth-brooders, and nest-builders.

Egg-scatterers: These species simply scatter their adhesive or non-adhesive eggs to fall to the substrate, into plants, or float to the surface. These species do not look after their brood and may even eat their own eggs. These, fish spawn in groups or in pairs. Often there is a large number of the small eggs laid. The fry hatch quickly.

Egg-depositors: These species deposit their eggs on any of the substrata such as a tank glass, wood, rocks, plants, etc. Egg depositors usually lay less eggs than egg-scatterers, although the eggs are larger.

Egg-burriers: These species usually inhabit waters that dry up at some time of the year. The majority of egg burriers are annual Killifish, which lay their eggs in mud. The parents mature very quickly and lay their eggs before dying when the water dries up. The eggs remain in a dormant stage until rains stimulate hatching.

Mouth-brooders: species that carry their eggs or larvae in their mouth.

Nest-builders: Nest builders build some sort of nest for their eggs. The nest is usually in the form of bubble-nest formed with plant debris and saliva-coated bubbles (labyrinth fish, catfish), or a excavated pit in the substrate (cichlids). Nest builders practice brood care.

Conditioning of parent fish: Before placing the parent fish together for spawning, they should be conditioned. Conditioning is feeding the fish with a variety of healthy foods to get them in top condition for spawning. Many species can be conditioned using a well-balanced flake food, though others should be conditioned on live foods such as brine shrimp, insect larvae, and flying insects. The parent fish can be separated while conditioning. This way, when the fish are reintroduced, they are eager to spawn.

Spawning tank: Though some species readily spawn in the aquarium, the eggs or fry often do not survive because of predatory parents or other fish. Often the fry die because of unfavourable, water conditions. Many species that practice brood care will harm other tank mates in attempting to guard the eggs. Because of all these problems; most aquarists who breed fish use a separate spawning tank. The spawning tank should be like the hospital tank with protected heater so the fish are not burned; a slow-moving filter (sponge filter), so the eggs or fry are not sucked up; and good aeration. Depending on the spawning method, the spawning tank can be set up in a number of different ways.

Stimulating spawning: One of the best ways to induce fish to spawn, especially difficult-to-spawn species, is to simulate natural conditions. Among factors that encourage fish to spawn are the environment, the food, and the rainy season.

Water conditions: The right water conditions are among the most basic requirements in spawning fish. Thus the water conditions should be similar to those in the natural environment of the species. Another important environmental conditions is the right tank set-up including hiding places, spawning sites, lighting, water current, and social conditions (schools).

Food: The right foods are important to encourage spawning. Without proper foods, natural conditions cannot be entirely recreated. Some of the live foods that often can make a difference in spawning success are earth worm, mosquito larvae and fruit flies.

The rearing tank: A rearing tank is not required with species that take care of their young, although they are still recommended. For species that do not take care of their young, the rearing tank can be the same tank as the spawning tank as long as the parents are removed. The rearing tank should have a protected heater, a sponge filter and plastic or live plants. In addition, three of the tank sides should be covered with black paper, because a light can encourage fungal infections and cause discomfort for the fry. The water in the rearing tank should be similar to the water used for spawning.

Raising the fry: When the eggs hatch, the larvae that emerge look nothing like the parent fish. Instead, the larvae have a large, yellow yolk sac and are barely able to move, let alone swim. The larvae will feed off the egg sac until all the yolk is gone. Once the yolk sac disapperas, the hungry fry will begin to look for food. The fry of small fish can be first fed infusoria, “green water,” or egg yolk. Later these fry can be fed larger foods like whiteworms, Daphnia, Artemia nauplii, and ground flakes. These foods are good for slightly larger fry such as those of cichlids. Once the fish grow larger, larger foods like brine shrimp, larger Daphnia, flakes, insect larvae, and chopped Tubifex worms are accepted. 25-50% of the water in the rearing tank should be changed daily. Be sure that the “new” water added has characteristics like the water taken out, because fry are more sensitive to sudden changes in the water. The fry should be fed several times a day. Many species need periodic sorting by size, so that larger fish do not cannibalize

smaller fish. With favourable water conditions, regular water changes, and generous feeding, the fry should grow quickly. Unhealthy and deformed fish should be removed.

Common diseases and their control measures

A fair knowledge of fish diseases and the methods of their treatments along with prophylactic measures are indispensable in ornamental fish farming. Natural processes and man-made activities mainly cause diseases in ornamental fishes. Inadequate nutrition, unusual weather conditions, accumulation of feed and wastes in the rearing medium, unhygienic handling and other environmental factors are some of the reasons responsible for the emerging of certain diseases in ornamental fishes.:

Precautions to be taken to reduce the possibility of diseases

• Good-quality and compatible fish should be procured

• New fishes should always be quarantined before adding them to the aquarium. (A hospital tank can be used for this).

• Rough handling and sudden changes in tank conditions to be avoided

• Overfeeding of fish to be avoided

• Sick fishes should be given treatment in a hospital tank

• Nets used needs to be disinfected.

• Transferring water from the quarantine tank to the main aquarium to be avoided.

Bacterial diseases

(i) Red Pest

Symptoms: Bloody streaks on fins or body.

Treatment :

Aquarium should be treated with a disinfectant. Acriflavine (0.2%) solution may be used at the rate of 1 ml per litre.

(ii)Mouth Fungus

Symptoms: White cotton patches around the mouth.

Mouth Fungus is so called because it looks like a fungus attack of the mouth. It is actually caused by the bacterium Chondrococcus columnaris. It shows up first as a gray or white line around the lips and later as short tufts sprouting from the mouth like fungus. Penicillin at 10,000 units per liter is a very effective treatment. Second dose with chloromycetin, 10 to 20 mg per liter may be given after two days.

(iii)Dropsy

Symptoms: Bloating of the body, protruding scales.

Dropsy is caused from a bacterial infection of the kidneys, causing fluid accumulation or renal failure. The fluids in the body build up and cause the fish to bloat up and the scales to protrude. It appears to only cause trouble in weakened fish and possibly from unkept aquarium conditions. An effective treatment is addition of antibiotic such as chloromycetin (chloramphenicol) and tetracycline at the rate of 10 mg per liter of water.

(iv)Tail Rot & Fin Rot

Symptoms: Disintegrating fins that may be reduced to stumps, exposed fin rays, blood on edges of fins, reddened areas at base of fins, skin ulcers with gray or red margins, cloudy eyes. Tail and fin rot appears to be a bacterial infection of the tail and/or fins and may be caused by generally poor conditions, bully, or fin nipping tankmates. An effective treatment is addition of antibiotic such as chloromycetin (chloramphenicol) and tetracycline at the rate of 10 mg per liter of water.

Protozoan diseases

(i)Velvet or Rust

Symptoms: Clamped fins, respiratory distress (breathing hard), yellow to light brown "dust" on body.

This disease has the appearance of a golden or brownish dust over the fins and body. The fish may show signs of irritation. The gills are usually the first thing affected. Danios seem to be the most susceptible, but often show no discomfort. This disease is highly contagious and fatal. The best treatment is with copper at 0.2 mg per liter (0.2 ppm) to be repeated once in a few days if necessary. Acriflavine may be used instead at 0.2% solution (1 ml per liter). As acriflavine can possibly sterilize fish and copper can lead to poisoning, the water should be gradually changed after a cure has been effected.

(ii)Costiasis

Symptoms: Milky cloudiness on skin.

Similar treatment followed for velvet diseases may be done.

(iii)Ich (Ichthyphthiriosis)

Symptoms: Salt-like specks on the body/fins. Excessive slime. Problems breathing (ich invades the gills), clamped fins, loss of appetite. The drug of choice is quinine hydrochloride at 30 mg per liter (1 in 30,000). Quinine sulphate can be used if the hydrochloride is not available. The water may cloud but this will disappear. By reducing the time (with raised temperature) of the phases, you should be able to attack the free swimming phase effectively.Most commercial remedies contain malachite green and/or copper, which are both effective.

Fungal diseases

Fungus (Saprolegnia)

Symptoms: Tufts of dirty, cotton-like growth on the skin, can cover large areas of the fish, fish eggs turn white.

Fungal attacks may lead to other health problems like parasitic attack, injury, or bacterial infection. The symptoms are a gray or whitish growth in and on the skin and/or fins of the fish. Eventually, if left untreated, these growths will become cottony looking. The fungus, if left untreated, will eventually eat away on the fish until it finally dies.

Treatment: Use a solution of phenoxethol at 1% in distilled water. 10 ml of this solution to be added per liter of aquarium water. The treatment should be repeated after a few days if needed. If the symptoms are severe the fish can be removed from the aquarium and swabbed with a cloth that has been treated with small amounts of povidone iodine or mercurochrome. For attacks on fish eggs, most breeders will use a solution of methylene blue adding 3 to 5 mg/l as a preventative measure after the eggs are laid.

Parasitic diseases

(i) Fish louse (Argulus)

Symptoms: The fish scrapes itself against objects, clamped fins, parasites about 1/4 inch in diameter are visible on the body of the fish. The fish louse is a flattened mite-like crustacean about 5 mm long that attaches itself to the body of fish. They irritate the host fish, which may have clamped fins, become restless, and may show inflamed areas. With larger fish and light infestations, the lice can be picked off with a pair of forceps. Other cases can best be done with a 10 to 30 minute bath in 10 mg per liter of potassium permanganate, or treat the whole tank with 2 mg per liter, but this method is messy and dyes the water.

(ii) Anchor Worm (Lernaea)

Symptoms: The fish scrapes itself against objects, whitish-green threads hang out of the fish skin with an inflamed area at the point of attachment. Anchor worms are actually crustaceans. The young are free swimming and borrow into the skin, go into the muscles and develop for several months before showing. They release eggs and die. The holes left behind are ugly and may become infected. The anchor worm is too deeply imbedded to safely remove. Treatment can best be done with a 10 to 30 minute bath in 10 mg per liter of potassium permanganate. Or treat the whole tank with 2 mg per liter, but this method is messy and dyes the water.

(iii) Flukes

Symptoms: The fish scrapes itself against objects, rapid gill movement, mucus covering the gills or body, the gills or fins may be eaten away, the skin may become reddened. There are many species of flukes, which are flatworms about 1 mm long, and several symptoms that are visible. They infest gills and skin much like ich, but the difference can be seen with a hand lens. You should be able to see movement and

possibly eye spots, which is not found in ich. Gill flukes will eventually destroy the gills thus killing the fish. Symptoms of a heavy infestations are pale fish with drooping fins, rapid respiration, glancing off aquarium decor, and /or hollow bellies. Treatment can best be done with a 10 to 30 minute bath in 10 mg per liter of potassium permanganate.

(iv) Nematoda

Symptoms: Worms hanging from the anus. Nematodes (threadworms) infect just about anywhere in the body but only shows itself when they hang out of the anus. A heavy infestation causes hollow bellies. Lighter infestations usually cause no problems with the fish. Food containing thiabendazole as a nematode (threadworm) cure should be fed to the fish.

(v) Leeches

Symptoms: Leeches are visible on the fish's skin. Leeches are external parasites and affix themselves on the body, fins, or gills of the fish. Usually they appear as heart shaped worms (they are just curled up) attached to the fish. They are usually introduced to the aquarium via plants or snails. Since leeches are sucking and borrowing into the surface of the fish, removal with forceps can cause great damage, if not death, to the fish. If the fish is bathed in a 2.5 percent solution of salt for 15 minutes, most of the leeches should just fall off. Those that do not fall will be removed with forceps with minimal damage. Another treatment is to add Trichlorofon at 0.25 mg/l to the aquarium. Live plants should be removed and treated with potassium permanganate at 5 mg/l before replanting.

Transport of ornamental fishes

As most of the ornamental fish produced in Southeast Asia are destined for export, the fish must not only be attractive but also robust to withstand long air transportation. For consignments from Asia to USA, shipping may cost more than the fish in the consignment. Hence modern packaging technology to increase fish loading density and improve post – shipment survival assumes importance. The exporters are responsible for post – shipment survival of fishes. Warranty is given to customers by exporters that the death of fish after 7 days of arrival should not exceed more than 5%. If it exceeds 5%,losses will be compensated by the exporters.

Fish packaging system

Packaging of fish in polythene bags filled with water that is pretreated with chemicals and over saturated with pure oxygen. After packing, bags are placed in a Styrofoam box to provide thermal insulation to prevent sudden change in temperature of the transport water. Fish loading density depends on the transit time (eg. The transit time from Singapore to Europe is 30 hours). The fish loading density (Biomass/g) per unit volume of water (L) increases with increasing body weight. As large fish consume less oxygen and produce less nitrogenous wastes per unit weight than small ones.

Steps to be taken while transporting fish

1. Control of temperature of transport water : Metabolism during transport is about three times higher than the routine metabolism. Low temperature lower the metabolic rate thus reduce oxygen consumption and accumulation of CO2 and NH3 fish can tolerate upto 22oC.

2. Control of metabolic wastes: Ammonia and CO2 are the two major metabolic wastes produced in transport water. Bacterial growth is another major source of metabolic waste . To remove ammonia, zeolite is used (15-20 g / litre water). To prevent bacterial growth neomycine sulphate, methylene blue and acriflavine are used.

3. Osmoregulatory disfunction : When fish are exposed to transport stress, osmoregulatory dysfunction is common in fish. Addition of salt to transport water is effective in reducing the osmoregulatory dysfunction (0.5-3% salt).

4. Stress resistance test : Saline water is used to test the ornamental fishes for stress resistance. For guppies 35 ppt, for swordtail and platy 25 ppt, for tetra 15 ppt salinity used. The fish activity is observed for 2 hours.

Conditioning of fish for packaging

Three stages :

1. Prophylactic treatment

2. Starvation

3. Pre-packing

Prophylactic treatment :

1 day to 1 week.

Need of prophylactic treatment : To prevent post-shipment mortality, prophylactic treatment is essential. Post-shipment mortality is partly associated with less stress resistance of fish. Hence resistance of fish to stress has to be enhanced by nutritional prophylaxis and health prophylaxis.

Nutritional prophylaxis : The ornamental fishes for export should be resistant to stress. Hence fish should be given nutritious feed for developing strong fish. Feed supplementation of vitamin C enhances stress resistance in fish.

Health Prophylaxis : Healthy fishes alone should be transported in order to avoid mortality. Even infection is mild (harmless infection) the fishes should not be selected for export. When fishes are exposed to abnormal situation stress is unavoidable. Transportation creates stress. If fishes with mild infection are selected for transport corticosteroid level in plasma will be elevated and therefore immune suppresiveness results. It increases vulnerability of the fish to pathogens. Hence even harmless infection

may become lethal. Therefore only healthy fishes should be selected for transport. In order to enhance health the immunity of fish should be enhanced by suitable feeds.

Starvation : To reduce amount of excreta during transport (1-2 days).

Pre-packing : Fishes are placed in air-conditioned room at 22-23oC to enable them to acclimate packing conditions, crowding and low water temperature. Fish that fails to adapt to the packaging conditions and show signs of sickness are eliminated.

Acclimation and recovery of fish after shipment : After shipment the fishes should not be stocked directly in the aquarium tank. The fishes should be acclimatized for the new environment. The fish bag should be floated for 30 minutes to equalize the temperature of water.

Important marine ornamental fishes

Family : Pomacentridae

1. Damesl : Dascyllus trimaculatus (Three spot Damsel)
   They lay eggs on rocks or pots.
2. Clown or Anemone fish – Amphiprion sp. (A. clarkia)

Family : Pomacanthidae

1. Marine Angel : Pomocanthus sp. and Centropyge sp.
   Angel has spine on the gill cover.

Family : Chaetodontidae

1. Butterfly fish : Chaetodon sp. It has long shout to feed in the corals.

Family : Acanthuridae

1. Surgeon – Acanthurus sp.
2. Tang – Zebrasoma flavescens (yellow tang)

Other important marine ornamental fishes

Blennies	Wrasses
Hawk fishes	Grammas
Gobies	Cat fishes
Squirrel fish	Lion fishes
Jaw fishes	Sea horses and pipe fishes
Box fishes	Puffer fish
Rabbit fish	Porcupine fish
Sea bass	Trigger fish
Groupers	Mandarins

Important characters

1. Marine ornamental fishes are beautiful fishes.

2. They found in coral reefs.

3. High care should be taken to maintain marine ornamental fishes in aquarium.

4. Good water quality with high dissolved oxygen. Very low nitrite and ammonia. Hence filters are used to reduce ammonia.

5. They fetch higher price than freshwater in the international market.

Captive breeding is successful only in few marine ornamental fishes

Breeding of clown fish and sea horses

1. Clown fish

The popular clown fish is brown colour body with two to three white bands. They have symbiotic relationship with anemones. In an aquarium, one pair of clowns will become dominant and this will harass others or even kill. Clown fish feeds both live and frozen foods.

Breeding: The naturally paired anemones are introduced in the aquarium or breeding tank along with anemones. Rocks are provided in order to facilitate the female to release eggs. The male clean the rock. Then the female releases 200-300 eggs and male guard the eggs. The eggs are yellowish in colour. In due course of time, they turn to dark colour. Hatching takes 7-10 days. The fry are separated and given rotifiers.

2. Sea horse

Sea horses are very poor swimmers. They have very small mouth. They anchor most of the time to the corals with their tail.

Breeding: They have an interesting method of reproduction. The male carries the eggs in a brood pouch on his belly. During courtship the female came close to male and expels eggs from its oviduct to the brood pouch of male. Fertilization takes place when the eggs are in the pouch. Incubation period is 2 to 8 weeks. After that the fry are released from the pouch. Fine live foods are give to raise the fry.