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Breeding, Seed Production and Rearing of Coldwater Ornamental Fishes in Aquarium

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भा.कृ.अनु.प.-शीतजल मात्स्यिकी अनुसंधान निदेशालय
ICAR-Directorate of Coldwater Fisheries Research
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Foreword

ICAR-Directorate of Coldwater Fisheries Research is recognized as the premier Institute for undertaking research and development of hill fisheries in India. The holistic, meticulous and innovative research efforts taken for advancement and management of aquatic resources in Indian hill states for sustainable fish production and conservation has been commendable. Efforts have also been made for exploration of coldwater ornamental fish bio-diversity in IHR and to propagate them for development of a suitable breeding and seed production protocol in aquarium.

It's time to reinforce and re-vigorate ourselves to take further strides in coldwater fisheries research and development particularly in coldwater ornamental fish sector to provide livelihood security of the hill farmers. We have to live up to the expectation of the farmers who are looking to us for new cost effective technologies for their sustainable livelihood. We need to explore new research areas, which might not have been our priorities before.

I strongly believe that the research and development efforts carried-out at this directorate for the development of breeding, seed production and rearing protocols of selected coldwater ornamental species will encourage the youth and women entrepreneurs to take up this venture, which in turn will enhance their income.

I congratulate the team of scientists and staff of this directorate for bringing-out this bulletin, which will be highly beneficial for the diverse stakeholders.

Dr. Debajit Sarma
(Director, Acting)

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1. Aquarium Management

An aquarium is not just as a glass case holding water and fish. It is a fragile microhabitat where fish, plants, invertebrates, and microorganisms live together in a delicate balance. In a properly functioning aquarium, these organisms support and depend on each other to maintain a habitable environment. If this balance is disturbed, the result can be a break-down that can cause the animals to suffer or die. Such disturbances can be caused by many factors, such as:

- Too much or too little food
- Inadequate or improper maintenance
- Incorrect or fluctuating temperature
- Stressful environment
- Introduction of parasites or other disease
- Incompatible tank mates

Some guidelines to help avoid these problems are:

- Be sure the tank is located in an area that avoids extremes in temperature or fluctuations in temperature, such as windows, doors, heater or air conditioning vents, etc.
- Also, purchase a good quality heater and thermometer. Cheap heaters will eventually malfunction, either by sticking in the "ON" position, cooking all your fish to death, or in the "OFF" position, allowing them to die from chill. Many people tend to skimp on the heater, but a quality heater is worth the cost in the long run.
- When cleaning aquarium glass and equipment, use clean, warm water. Never use any detergents or spray cleaners, or any pads, rags, or sponges that have ever been used with any chemicals or soaps in the past
- To avoid adding parasites and diseases, always quarantine new fish in an isolation tank for two weeks before adding to the main tank.
- Purchase only fish that are healthy and show no signs of stress and disease. The fish should look well fed. Avoid buying fish from any store with sick fish, unless they show that they are quarantined.
- If your fish do become sick, use medication only according to the directions

of a knowledgeable professional. Treating incorrectly can cause many more problems.

Compatibility encompasses many different factors. Before adding any fish or invertebrate, here are a few things to check for:

- Be sure that the new addition is not predatory towards your other tank inhabitants. This sounds obvious, but it is a common mistake. Sometimes it is difficult to tell, for it may look perfectly harmless. Research is important here to be sure that not only will it not make a meal out of the current residents, but that it will not become a meal! Also, even if it is too small to devour a fish altogether, some fish are known as "fin nippers", and will tear holes in a fish's fins and scales, killing it slowly.
- Check the size of the animal as an adult. Many fish are sold when young and colorful; before they grow into large, aggressive behemoths.
- If the tank is a community tank, check to see that the fish requires the same water conditions, such as pH, hardness and temperature.
- If you have plants, make sure it will not eat them.
- Be certain that there is enough capacity for it in your tank. Overcrowding is an easy and common mistake to make.

Water Changes

The solution to pollution is dilution; water changes replace a portion of "dirty" water with an equal portion of clean water, effectively diluting the concentrations of undesirable substances such as nitrates phosphates that are not removed by any of the filtration methods in your tank. In an established tank, nitrate is the primary toxin that builds up. Regular water changes are the cheapest, safest and most effective way of keeping nitrate concentrations at reasonable levels. Water changes also serve to replenish trace elements, and to clean the gravel of accumulated detritus and waste.

By most accounts freshwater systems need partial water changes on a regular basis. The recommendation is to change about 25% every two to three weeks. In deciding how much and how often you wish to do water changes, keep in mind that for stability, smaller water changes done frequently are better.

The following is a simple guideline for making a water change:

- Unplug all of the electrical equipment for the tank except the light. Power filters and other pumps can overheat if run dry, and heaters often crack when the tank is refilled.

- Clean the inside glasses with an aquarium scrubber or scraper (no soaps or detergents, of course). Make slow, easy movements to avoid panicking the fish.
- Redecorate the tank and prune any dead leaves from live plants. Move the rocks and other ornaments around a bit, and then carefully stir up the gravel. Then bank the gravel so that it is higher in the back corners of the tank and lowest in the front middle. Let things settle for a few minutes; much of the now-floating waste will accumulate in the low spot.
- Siphon out about one third of the water, either into buckets or, if possible, directly into a drain.
- Fill the aquarium with chlorine free water. Add aquarium salt (one tablespoon per five gallons of water changed) if desired.
- Don't forget to plug all of the accessories back in.
- As a final touch, clean the cover, light and outside glasses of the tank.

Lighting: Unless the aquarium contains live plants, the aquarium light does not need to be on except while feeding or observing the fish. Room light is generally sufficient to keep the fish active during the day and leaving the aquarium light on for too long can cause unsightly algae growth.

Feeding: Most common aquarium fish should be fed two or three times per day, but each feeding should consist of only as much as is consumed in two or three minutes. "Overfeeding" is the main cause of depleting the water quality in your tank. Uneaten food is the main cause of water cloudiness, rapid algae growth, and often leads to fish disease. Alternating feedings among flake, freeze-dried, pelleted and live foods will provide a well balanced diet for fishes of various feeding habits.

Observing: It is important to take a few moments each day to simply look at the aquarium fish. Did every fish get something to eat today? Perhaps some are picky about the type of food they will accept; or maybe others are being intimidated by the tank bully at mealtimes. Do all the fish appear to swim, breathe, and otherwise act normally? It takes some experience of course to determine what is "normal" for each type of fish, but daily observation will provide that experience. And finally observe that there, are there any signs of torn fins, discoloration, white spots, red blotches or other signals of disease? If so, takeout the sick fish in a separate tank and treat them with proper treatment.

Checking equipment: The various pumps, filters and heaters typically installed on aquariums might well be referred to as the Life Support System. Checking to make sure all other equipment is also plugged in, turned on, and operating properly takes only a few additional seconds and may well pre-empt a developing disaster.

2. Water Quality Management for Coldwater Aquarium Fishes

In the aquarium or pond, fish are living in a much smaller volume of water and any changes in its chemistry will obviously have a much greater impact due to the fact that the 'dilution factor' is lower than that in the natural environment.

The fish and plants that we keep in aquaria and ponds originate from all over the world and an understanding of how the chemistry and quality of the water varies from region to region is all-important. The aquarist needs to understand and be able to alter the chemistry of his or her local water supply to that required by the fish, and also monitors water for any buildup of toxic, potentially harmful materials.

Water

The most common and convenient source of water for use in the aquarium or pond comes from the tap. Tap water is specifically treated to make it fit for human consumption and unfortunately some of the chemicals used in its treatment, such as chlorine, are highly toxic to fish. For successful fish keeping, tap water needs to be conditioned for aquarium and pond use. The easiest and most effective way to do this is to add dechlorination reagents to any tap water used. These products generally contain sodium thiosulphate but many also have added protective colloids to reduce the stress on the fish caused by raw tap water. This will eliminate potentially dangerous chlorine and other toxic substances. Aqua Safe also contains powerful colloids, which protect the delicate skin and gill membranes of fish, aiding the regeneration of damaged tissues.

Except in cases of gross pollution, it is never good practice to change all the water in an aquarium at once, as the sudden change in water chemistry can be potentially harmful to the fish. It is far better to carry out regular partial water changes of 10-20% every 2-3 weeks.

Maintaining correct water quality

Many problems that occur in the aquarium can usually be traced back to incorrect water quality. The following are the most important aspects to consider when keeping fish.

pH (potential of Hydrogen)

It is important to monitor pH because if a fish is forced to live in a pH level outside its preferred range, its slime coat can suffer, making it susceptible to disease. Its fecundity drops and, ultimately, the gas exchange in the gill membranes will be so reduced that the fish may suffocate. A simple test kit, which exhibits characteristic colour changes at different pH values or a hand-held electronic meter, can be used to test pH. Always remove a sample of water from the aquarium to measure the pH with an electronic meter.

The fish and plants that we keep in aquaria and ponds originate from all over the world and an understanding of how the chemistry and quality of the water varies from region to region is all-important. The aquarist needs to understand and be able to alter the chemistry of his or her local water supply to that required by the fish, and also monitors water for any buildup of toxic, potentially harmful materials.

If the pH in an aquarium or pond is not correct for the fish species present it can have an adverse effect on the fish health. Measuring pH can be a good way of monitoring when water changes are required. Acid conditions can often result from an excess of waste products (producing carbonic acid) in the aquarium and a surplus of wastes can weaken fish eventually causing disease and death. In a well-established tank it is possible this can create a natural acid buffer, which will resist changes to a more acceptable pH. If this begins to occur, check and see if the substrate is abnormally dirty or if using an undergravel filter checks it is not clogged.

Dissolved Oxygen

Like all animals, oxygen is essential to the survival of fish. Fish require oxygen to breathe and bacteria require oxygen to breakdown wastes. The consumption of oxygen by nitrifying bacteria will depend on the amount of wastes entering the system. Oxygen enters the water primarily through direct diffusion at the air-water interface and from aquatic plant photosynthesis. However, most indoor aquarium systems lack sufficient photosynthesis. Therefore, mechanical means of aeration is the only alternative for supplying oxygen to aquatic animals maintained in these systems. Providing surface agitation to aquarium water through a series of diffusers (airstones) with a small airlift pump or compressor will increase the oxygenation of the water. Other methods of oxygen injection include spray/degassing towers and venturi injection (suction of air under water pressure). Aquarium systems generally require some form of aeration or surface agitation to maintain dissolved oxygen at safe levels.

Oxygen levels can change dramatically over a 24-hour period and should be checked at various times of the day and night, with particular attention paid to times of known low oxygen. Levels are usually lowest in the morning and highest in late afternoon. Warm water is much less capable of holding oxygen gas in solution than cool water. This physical phenomenon puts the fish in double jeopardy because at high temperatures the metabolic rate is increased, hence their physiological demand for oxygen is increased. Therefore, dissolved oxygen in an aquarium must be maintained above levels considered stressful to the fish. As a general rule of thumb, levels should be maintained above 5.0 mg/L. When dissolved oxygen concentrations drop below 2.0 mg/L, fishes will be severely distressed, and when concentrations fall below 1.0 mg/L, they will begin to die. Prolonged exposure to non-lethal, low levels of dissolved oxygen constitutes a chronic stress and will cause fishes to stop feeding, reduce their ability to digest food, and make them more susceptible to disease.

Water Hardness

Hardness is commonly confused with alkalinity. The confusion relates to the term used to report both measures, milligrams per litre as calcium carbonate (mg/L $CaCO_3$). Calcium carbonate is a general term that indicates the total quantity of divalent salts present and does not specifically identify whether calcium, magnesium and/or some other divalent salt is causing water hardness. Calcium and magnesium ions are the most common factor that comprises hardness and aquarium test kits usually determine both ions as "total hardness". Despite the much-confused state of misinformation prevalent in the hobby, permanent or general hardness is true hardness; carbonate hardness (dKH) is not hardness at all but alkalinity. Hardness should be expressed as a concentration of divalent ions in mg/L (ppm). The terms "permanent", "general", and "carbonate" hardness should be discontinued.

Calcium and magnesium are essential in the biological processes of fish (bone and scale formation, blood clotting, and other metabolic reactions). Fish can absorb calcium and magnesium directly from the water or from food. The major organs used are the gills for absorption and the intestine along with the kidneys. Calcium is the most important divalent salt in fish culture water and is maintained in the blood at levels higher than the environmental level. The presence of calcium in aquarium water helps reduce the loss of other salts; for example, sodium and potassium from the fish's blood.

Sodium and potassium are also important salts in fish blood and are critical for normal heart, nerve, and muscle function. Research has shown that environmental calcium is also required to reabsorb these lost salts. In low calcium water, fish can lose substantial quantities of sodium and potassium into the water. However, it is not clear whether calcium plays an equally important role in embryonic development. A recommended range for free calcium in culture waters is 25 to 100 mg/L (50 to 250 mg/L $CaCO_3$ hardness). A low $CaCO_3$ hardness value is a reliable indication that the calcium concentration is low. However, high hardness does not necessarily reflect a high calcium concentration.

Water hardness is expressed in a confusing array of scales, although in the aquarium hobby the influence is to express them in terms of milligrams per litre of Calcium carbonate (mg/L $CaCO_3$), which is also equivalent to parts per million, and degrees German Hardness (dH). For aquarium purposes, you can use the following conversion factors:

DH × 17.9 = ppm
ppm × 0.056 = dH

Temperature

Fishes, unlike mammals, are unable to regulate their body temperatures and are thus subject to the temperature in their surrounding environment. Temperature regulates their metabolism and their need to take in nutrients. Therefore the temperature of the fish's environment is a major and even the deciding environmental factor in determining growth rate, metabolism, and nutritional efficiency. In fact, temperature will influence all biological and chemical processes in an aquarium.

Temperature tolerance among fishes is similar to that for water chemistry. In their natural environment, many are exposed to temperatures that vary considerably. This is dependent on the size and depth of the body of water, water flow, whether exposed to the sun or in shaded rain forest streams, the time of day and the season. The overall range has been reported from a low of -5^{O}C to as high of 36^{O}C and even higher in a shallow body of water exposed to full sun at midday. However, these temperatures are conditions that wild fishes have to be able to endure to survive and are not recommended for aquarium keeping.

In their natural environment, fishes can search for more favourable conditions by moving into cooler or warmer water. However, in captivity this is not possible. Each species has a preferred or optimum temperature range where it grows best. At temperatures above or below optimum, their growth is reduced and mortalities may occur at extreme ranges. A temperature range of 20 to 24^{O}C is suggested for general maintenance in captivity while an increase to 28^{O}C can be used for breeding purposes.

Nitrogen

When fish are maintained in an aquarium and fed protein-rich feeds, uneaten food particles and some by-products of digested food, namely amino acids and proteins, become major sources of organic compounds that accumulate on the gravel bed and in the filters. These wastes are ultimately metabolised by heterotrophic bacteria to ammonia. Heterotrophic bacteria use solubilised organic sources of carbon from proteins, fats, and carbohydrates to build their body components. Bioconversion of dissolved organic material by heterotrophic bacteria is a precursor to nitrification as high levels of soluble organic products can inhibit nitrification.

In the aquarium wastes excreted by fish are in the form of ammonia and urea. At a pH range of 6-8 approximately 90% of the total nitrogenous waste is excreted across the gills, with ammonia accounting for approximately 85% of this total. Excretion of urea usually makes up the remaining 10-20%. The amount of ammonia excreted by fish varies with the amount of feed put into the aquarium, accelerating as stocking and feeding rates increase. In well-planted tanks most of the ammonia is taken up directly by the plants (including algae), as most plants prefer ammonia if given a choice. When nitrate is used, the nitrate must first be reduced to ammonia (the reverse of nitrification). However, in the average aquarium most of the ammonia will be converted by nitrifying bacteria to nitrite, and then nitrate.

Ammonia is toxic to fish and must be removed or converted into benign substances before it builds up to lethal levels. It exists as a mixture of two forms, unionised ammonia (NH_3) and ionised ammonia (NH_4+) in equilibrium. This does not mean that they are present in equal proportions, but that they are converted from one to the other at an equal rate depending upon the pH and temperature of the water. At a pH of 7.0 most of the ammonia is in the ionised form while at a pH of 8.0 the majority is in the unionised form. As the pH falls, the ammonia equilibrium shifts in the direction of ionised ammonia (ammonium) - the total ammonia does not change.

Total ammonia (NH_3+ NH_4^+) in mg/L or ppm is most commonly measured with a test kit. Most test kits measure the sum of both forms of ammonia. The only way to know how much ammonia is in the toxic form is by determining the pH and temperature and then calculating the percentage in toxic form. Unionised ammonia can be mathematically calculated from based on water temperature, pH, and total ammonia levels. High temperatures and high pH levels can cause lethal concentrations of unionised ammonia, which is probably responsible for more unexplained fish losses in aquariums than anything else.

Unionized ammonia is a dissolved gas in water that can pass unimpeded through the membranes of the fish's gills. Continuous exposure to more than 0.02 ppm of the unionised form can cause reduced growth, increased susceptibility to disease and premature death. Ionised ammonia (ammonium) does not exist as a gas and cannot pass through the gill membranes and is therefore, relatively non-toxic. It can, however, in high concentrations, produce external burns that are identical to acid burns. This is often seen when fish are crowded in shipping bags.

If a test kit gives a reading of 1 ppm for total ammonia at 25ºC, in fresh water, this means that at pH = 7.0 the toxic form is 0.6% of the total or 1 ppm x 0.006 = 0.006 ppm NH_3, but at pH = 8.5 the toxic form is 15% of the total or 1 ppm x 0.15 = 0.05 ppm NH_3. Another factor to consider is the units that the test kit measures. Ammonia contains nitrogen (N) and hydrogen (H). Some kits may report total ammonia, as described above, but other kits refer to the quantity of nitrogen in the ammonia molecule. In this case the test kits units are presented as total ammonia nitrogen, which is the sum of NH^3 N + NH^4 N. Results reported in the two forms are not the same. It is necessary to know the percentage of nitrogen in the ammonia molecule to compare the two units. The atomic weight of nitrogen is 14 and that of hydrogen is 1; thus the molecular weight of NH_3 is 14+3 = 17. Nitrogen is 14/17 or 82% of the weight of the ammonia molecule. The difference is much more important for nitrite and nitrate. Thus 1 ppm of NH^3 is the same thing as 0.82 ppm of NH^3 N. It is essential to know what units are being measured with each test kit.

Nitrate (NO_3) is the end product of nitrification and is normally not toxic to fish even in high concentrations. Levels of up to 200 ppm are tolerated by some fish species however, ideally it should be maintained below 20 ppm. Nitrate accumulation in aquaria can be controlled by regular water changes and can also be converted to nitrogen gas under special conditions.

Since the major source of ammonia/nitrite is feeding fish, the first thing to do when any quantity is present in the water is to reduce or stop feeding for a 48-hour period. Fish are not likely to eat during periods of ammonia/nitrite stress and the uneaten food will only make the situation worse. Overfeeding is a major cause of ammonia and nitrite problems, and stopping the feeding will allow the natural nitrogen cycle to catch-up with the nutrient load.

Water changes of 10-25% per day for a week or so is also beneficial, as it will help to remove some of the ammonia and nitrite. Reduce the number of fish in the aquarium and check the filtration system for possible malfunction or improper size. By testing the water on a regular basis, most problems can be minimised, since corrective measures can be taken before fish start to die. Once fish have started to die, it is difficult to correct the problem without losing more fish.

For a long time, the aquarium hobby has believed that the bacteria responsible for nitrification in freshwater aquaria were *Nitrosomonas europaea*, which oxidises ammonia to nitrite, and *Nitrobacter winogradskyi* that oxidises nitrite to nitrate. However, recent research has shown that the most numerous ammonia-oxidising bacteria were related to *Nitrosococcus mobilis* and the nitrite-oxidising bacteria in our aquaria are members of the genus *Nitrospira*.

Fraction of toxic (unionized) ammonia in aqueous solutions at different pH values and temperature. Calculated from data in Emerson *et al.* (1975).

To determine the amount of unionized ammonia present, get the fraction of ammonia that is in the unionized form for a specific pH and temperature from the table below. Multiply this by the total ammonia nitrogen present in a sample to get the concentration in ppm (mg/L) of toxic (unionized) ammonia.

Temperatures (°C)

pH	20	22	24	26	28	30
7.0	0.0039	0.0046	0.0052	0.0060	0.0069	0.0080
7.2	0.0062	0.0072	0.0083	0.0096	0.0110	0.0126
7.4	0.0098	0.0114	0.0131	0.0150	0.0173	0.0198
7.6	0.0155	0.0179	0.0206	0.0236	0.0271	0.0310
7.8	0.0244	0.0281	0.0322	0.0370	0.0423	0.0482
8.0	0.0381	0.0438	0.0502	0.0574	0.0654	0.0743
8.2	0.0590	0.0676	0.0772	0.0880	0.0998	0.1129
8.4	0.0904	0.1031	0.1171	0.1326	0.1495	0.1678
8.6	0.1361	0.1541	0.1737	0.1950	0.2178	0.2422
8.8	0.1998	0.2241	0.2500	0.2774	0.3062	0.3362
9.0	0.2836	0.3140	0.3456	0.3783	0.4116	0.4453

Source:
Emerson, K., R.C. Russo, R.E. Lund, and R.V. Thurston. 1975. Aqueous ammonia equilibrium calculations effect of pH and temperature.
Journal of the Fisheries Research Board of Canada. 32: 2379-2383.

Hardness

Hardness is a measure of dissolved mineral salts, mainly calcium and magnesium carbonates, in water. The more dissolved salts, the harder the water. Hardness has a direct effect on the cellular functions of fish, plants and microorganisms and although fish from hard water areas do not seem to suffer from softer than natural conditions the reverse does not apply. Many plants in particular perish in hard water and it is thus necessary to choose the aquarium decor and substrate accordingly to create a hardness indicative of the fishes natural habitat, especially if soft water is a requirement. To test decor or gravel for calcium and magnesium carbonates, add a sample to vinegar (which contains acetic acid). If it fizzes then it contains calcium and / or magnesium carbonates and one should consider the hardening effect it will have on the water.

Three types of hardness are of interest to the fish keeper. Temporary hardness, caused by calcium and magnesium bicarbonates, permanent hardness caused by calcium sulphate, and total hardness (GH) - a combination of temporary and permanent hardness.

Temporary hardness is sometimes referred to as carbonate hardness (KH) or acid binding capacity ,and is easily removed by boiling. Boiling takes out bicarbonates of calcium and magnesium, which are soluble in water, by precipitation. The fraction of total hardness, which cannot be removed by boiling, is called permanent hardness. Permanent hardness can therefore be determined by subtracting the figure for temporary hardness from the figure of total hardness.

Carbonate hardness (KH) may often be greater than total hardness (GH) because of the presence of sodium and potassium in addition to calcium and magnesium. These elements do not increase hardness but occur along with bicarbonate anions to increase the quantity of bicarbonates.

The majority of fish prefer hardness below 200 ppm but cichlids may prefer higher values of up to 400 ppm.

To simplify the units further, the following common terms are generally used to describe hardness, which is given below in the table.

ppm $CaCO_3$	Common Term
0-50	Very soft
51-100	Soft
101-200	Medium hard
201-300	Fairly hard
301-450	Hard
Over 451	Very Hard

The units used to measure alkalinity will depend on the test kit. Some use milliequivalents (meq/L), dKH (German Degrees), mg/L or parts per million (ppm). meq/L stands for milliequivalents per litre. A milliequivalent is 0.001 of an Equivalent, which is the weight of substance that will react with one atomic weight of hydrogen.

For aquarium purposes, you can use the following conversion factors:

50 ppm (mg/L) = 1 meq/L = 2.8 dKH.

Dissolved Solids

Total dissolved solids (TDS) is a measurement of the total amount of dissolved substances in water and expressed in ppm of NaCl. TDS is essentially the same as conductivity. For aquarium applications it is recommended that the conversion formula TDS (in ppm) × 0.64 = EC (in μS/cm) be used. The conversion formula is only an approximation. TDS meters are calibrated with a Sodium chloride solution.

3. Breeding, Seed Production and Rearing of Coldwater Fishes in Aquarium

(1) Chocolate mahseer, *Neolissochilus hexagonolepis* (McClelland, 1839)

Chocolate mahseer (*Neolissochilus hexagonolepis)* is a highly esteemed food and game fish of North-eastern region. This fish is considered as a threatened species and hence needs special attention to conserve for increasing its population in the natural water bodies. Fish is considered as a threatened species and hence needs special attention to conserve for increasing its population in the natural water bodies.

Taxonomic position:

Phylum: Chordata
Class: Actinopterygii
Order: Cypriniformes
Family: Cyprinidae
Species: *Neolissochilus hexagonolepis* (McClelland, 1839)

Distribution

The fish is widely distributed in India, Bangladesh, Nepal, Myanmar, Thailand, Malaysia, Indonesia, China, Bhutan, Pakistan and Viet Nam.

At ICAR DCFR Bhimtal, chocolate mahseer naturally spawned record eight times in a year without use of any stimulating hormone in aquarium condition manipulating the environment.

Brood stock management

Brood stock in ratio of 2 females and 4 males having average weight of 800 and 650grams respectively were maintained in a wall aquaria of size 130x120x95cm with water holding capacity of 1200 L water. Glass tank was equipped with indigenously made PVC pipe under-gravel water filter that was covered with 18-20cm thick layer of sand gravels of 3-5 mm size. Filter was operated by a power-head water-pump. Sand gravel act as a substrate for biological filter to eliminate the toxic ammonia generated from metabolic activities of fish, decomposition of fecal matter and excess food.

Power-head water pump was continuously operated to maintain efficient water filtration system, providing continuous aeration and generating water current to simulate the water flow condition in the aquarium. In addition to this few rocks on thick layer of stone pebbles were kept to maintain a natural simulated hill stream riverine environment in the aquarium. A 500 Watt immersion thermostat heater were used to maintain 20-22^{0}C uniform temperature. Nearly

30% of the water were changed every alternate day by gravel vacuumed siphoning method to eliminate the accumulated waste materials for maintaining optimum water quality in the aquarium.

Secondary sexual characters

Secondary sexual characters in Chocolate mahseer are quite pronounced during the spawning season. Presence of tubercle on operculum of mature male and were absent in the females. Length of pectoral fins are comparatively larger in male. In females the bulkiness of the abdomen gives rise to an arched ventral profile whereas in males the profile is comparatively less arched. During breeding season it is easy to identify sexes when ripe females show a fully bulged and soft abdomen with a slightly swollen pinkish vent and anal fin. When the abdomen is slightly pressed the mature males will discharge milt. In natural environmental conditions like in ponds and lakes normally the males are bright in colour whereas the females have dull coloured bodies but in indoor conditions there is no marked difference in colorations.

Feeding

Brood stock were fed with trout pellet feed, aquarium fish feed and occasionally goat liver and heart.

Maturity

Oozing males were observed throughout the year.

Spawning Behaviour

In natural environment Chocolate mahseers migrate considerable distances upstream in shallow water area for spawning where they laid eggs in gravels and pebbles are abundant thus saved from being washed away by strong current. In the aquarium condition during spawning female vigorously vibrating its caudal fin over the gravel surface. With this act female sinks its lower body deep in the gravel layer and release the eggs which were simultaneously fertilized by chasing males.

Female releases small batches of eggs and most of the eggs releases in 8-12 attempts of mating act within a spawning period of 6-8 hours. During the spawning period the aquarium water becomes turbid due to frequent disturbance of gravel layer by spawner fish.

Eggs collection

After spawning the eggs were collected from the gravel pits and segregated from the gravel.

Eggs incubation, hatching and rearing

Eggs were incubated in a closed re-circulatory hatchery chamber made of

3x2x2 feet glass aquaria with water holding capacity of 250 L water, equipped with under gravel filtration system operated by a power-head water pump of 1250 L pumping capacity water per hour and a 300 W immersion glass thermostat heater to maintain uniform water temperature during incubation, hatching and rearing period. This incubation cum hatching device were indigenously designed at ICAR-Directorate of Coldwater Fisheries Research Bhimtal. Incubation of eggs were done in wheat flour plastic sieve trays which were remain floated in aquarium. About 1000 to 1500 eggs were placed in each hatching trays. 3-5 numbers of floating hatching trays were placed in the aquarium tank. Water temperature were maintained at 18-20^{O}C through immersion glass heater. Incubation and hatching take place 6-7 days in the tray itself. No water exchange were done during entire hatching period. Eggs were culled every alternate days. After hatching larvae were released in the same incubation chamber and reared 40-50 days up to fry stage. Larvae were fed on poultry egg suspension for 5-7 days and later were fed on wet feed made with poultry egg, wheat flour, vegetable oil, fish meal and vitamin mineral mix , suspension. Daily 25% of water were siphoned out by gravel vacuumed siphon to eliminate accumulated waste material on gravel surface. Fry to fingerling stage were reared in 6x2x2 feet FRP tanks equipped with under gravel filtration system.

Brood stock in Aquarium

Rearing of fry in Aquarium

Fertilising Eggs

Newly hatched hatchlings

Developing Eggs

Breeding observations: Chocolate mahseer, *Neolissochilus hexagonolepis* (McClelland,1839) in Aquarium tanks at ICAR-DCFR, Bhimtal

Table : Timing of Chocolate mahseer spawning at ICAR-DCFR, Bhimtal

Number of spawning	Date of spawning	Spawning period interval
First spawning	16.11.16	0 days
Second spawning	24.01.17	68 days
Third spawning	27.02.17	33 days
Fourth spawning	02.04.17	36 days
Fifth spawning	18.05.17	45 days
Sixth spawning	12.07.17	54 days
Seventh spawning	16.08.17	34 days
Eight spawning	19.11.17	94 days

Table : Recorded water quality parameters

Date of natural spawning	Water temp. °C	Water pH	DO	Number of eggs obtained	Hatching percentage	Incubation period	Free swimming stage
16.11.16	20	7.5	7.6	250	50%	5-7 days	10-12 days
24.01.17	18	7.4	8.2	1800	40%	6-8 days	11-13 days
27.02.17	19	7.8	8.0	600	62%	5-7 days	11-12 days
02.04.17	20	7.5	7.0	1400	50%	4-5 days	8-10 days
18.05.17	22	7.6	6.8	1500	45%	4-5 days	9-10 days
12.07.17	22	7.8	7.0	1000	55%	4-5 days	7-9 days
16.08.17	19	7.4	7.6	380	45%	5-6 days	8-9 days
19.11.17	20	7.5	7.0	1200	45%	4-5 days	7-9 days

Fertilized eggs collection:

- The fertilized eggs were demersal, pale yellow in colour and had a diameter of 2.0 – 2.5mm.
- Yolk occupied almost three-fourth of the egg mass
- Just prior to hatching, the embryo exhibits a characteristics rotary movement within the egg membrane which gradually becomes vigorous.

During hatching, tail emerges first and the hatching process is highly protracted and is completed in another 12 hours.

- Hatching rate varied between 40-55%
- Hatching completed in 50- 60 hours
- Newly hatched larvae measured about 10 to 11.0mm in length
- Color was transparent golden yellow
- Completely absorbed larva increased to 1.4 cm in length
- At this stage the larva started feeding

This study is an attempts to help in standardize the natural spawning and breeding technique of chocolate mahseer in controlled condition.

This fish is a batch spawner. With good brood stock management, hatching and rearing practices, mass scale seed production of chocolate mahseer is possible round the year which in turn will help in conservation of the fish in natural habitat as well as increased fish production from culture system.

Future research should focus on maximizing the seed production of this species.

Sexual dimorphism in Chocolate mahseer:

Male **Female**

(2) Golden mahseer, *Tor putitora* ((Hamilton, 1807)

Taxonomic position:

Phylum: Chordata

Class: Actinopterygii

Order: Cypriniformes

Family: Cyprinidae

Species: *Tor putitora* (Hamilton, 1807)

Golden mahseer, *Tor putitora* Hamilton, belongs to family Cyprinidae, is one of the largest freshwater fish found in Indian Himalayan rivers in the foot hills. The fish has a very attractive golden color, and one of the best sport fish for anglers. Due to indiscriminate fishing its population is continuously decreasing in its natural habitat. now the fish has been categorised as an 'endangered' species in the IUCN red list.

ICAR- Directorate of Coldwater Fisheries Research Bhimtal has achieved a breakthrough in natural spawning of Golden mahseer *Tor putitora* in confined aquarium without use of any stimulating hormone. Both the sexes attain sexual maturity and naturally spawned several times in the year 2017 and 2018.

Geographic distribution:

Tor putitora is widely distributed in south Asian countries like India, Afghanistan, Pakistan, Nepal, Bhutan and upto Myanmar.

Brood stock management:

Brood stock in ratio of 2 female and 6 males having average weight of 1200 and 800 grams respectively were maintained in a wall aquaria of size140x130x100 cm with water holding capacity of 1500 L water. Glass tank was equipped with indigenously made PVC pipe under-gravel water filter that was covered with 18-20 cm thick layer of sand gravels of 3-5 mm size. Filter was operated by a power head water pump. Sand gravel act as a substrate for biological filter to eliminate the toxic ammonia generated from metabolic activities of fish, decomposition of fecal matter and excess food.

Power-head water pump was continuously operated to maintain efficient water filtration system, providing continuous aeration and generating water current to simulate the water flow condition in the aquarium. In addition to this few rocks on thick layer of stone pebbles were kept to maintain a natural simulated hill stream riverine environment in the aquarium. Two numbers of 500 Watt immersion thermostat heater were installed in the aquarium to maintain uniform temperature in the range of 20-22^{0}C. Nearly 30% of the water were changed every alternate day by gravel vacuumed siphoning method to eliminate the accumulated waste materials for maintaining optimum water quality in the aquarium.

Feeding

Brood stock were fed with trout pellet feed, aquarium fish feed and occasionally goat liver and heart.

Maturity

Oozing male were observed throughout the year but female were mature in month of February and March.

Sexual dimorphism

In *T. putitora* very strong sexual dimorphism characters are not evident, although a few secondary characters have been observed during the spawning season. Males are comparatively bright coloured and have elongated body with rough pectoral fins, while females are deep bodied with a dull colour. In male operculum have some spiny rough tubercles.

Spawning Behaviour

T. putitora in the natural environment spawn during April–May and July–October. However, the most accepted season for spawning in *T. putitora* is the high floods during monsoon. Fish undertake a long migration that lasts from March to September and lay eggs in shallow waters with 0.5–3.5 m depth with stream beds of gravel, pebbles, silt and sand. They lay the eggs near river banks that are suitable spawning niches where the fish creates depressions to deposit eggs. While depositing eggs, females show vent, ragged and frayed appearance of caudal and ventral fins. In the aquarium condition during spawning female vigorously vibrating its caudal fin over the gravel surface. With this act female sinks its lower body deep in the gravel layer and release the eggs which were simultaneously fertilized by chasing males. Female releases small batches of eggs and most of the eggs releases in 5-8 attempts of mating act within a spawning period of 4-6 hours. During the spawning period the aquarium water becomes turbid due to frequent disturbance of gravel layer by spawner fish.

Average Fecundity: 3000 to 4500 eggs per spawning were obtained

Eggs are visible to the naked eye and range from 2.6to 3.2 mm in size. They are semi adhesive and demersal in nature.

Eggs collection:

After spawning the eggs were collected from the gravel pits and segregated from the gravel.

Eggs incubation, hatching and rearing

Eggs were incubated in a closed re-circulatory hatchery chamber made of 3x2x2 feet glass aquaria with water holding capacity of 250 L water, equipped with under gravel filtration system operated by a power-head water pump of 1250 L pumping capacity water per hour and a 300 W immersion glass thermostat heater to maintain uniform water temperature during incubation, hatching and rearing period. This incubation cum hatching device were indigenously designed at ICAR- Directorate of Coldwater Fisheries Research, Bhimtal. Incubation of eggs were done in wheat flour plastic sieve trays which were remain floated in aquarium. About 1000 to 1500 eggs were placed in each hatching trays. 3-5 numbers of floating hatching trays were placed in the aquarium tank. Water temperature were maintained at 18-20^{0}C through immersion glass heater. Incubation and hatching take place 6-7 days in the tray itself. No water exchange were done during entire hatching period. Eggs were culled every alternate days. After hatching larvae were released in the same incubation chamber and reared 40-50 days up to fry stage. Larvae were fed on poultry egg suspension for 5-7 days and later were fed on wet feed made with poultry egg, wheat flour, vegetable oil, fish meal and vitamin mineral mix , suspension. Daily 25% of water were siphoned out by gravel vacuumed siphon to eliminate accumulated waste material on gravel surface. Fry to fingerling stage were reared in 6x2x2 feet FRP tanks equipped with under gravel filtration system.

Fertilized eggs collection:

- The fertilized eggs were demersal, pale yellow in colour and had a diameter of 2.5 – 3.2mm.
- Yolk occupied almost three-fourth of the egg mass.
- During hatching, tail emerges first and the hatching process is highly protracted and is completed in another 12 hours.
- Hatching rate varied between 55-67%.
- Hatching completed in 50- 65 hours
- Newly hatched larvae measured about 10 to 11.0mm in length
- Color was transparent golden yellow.
- Completely absorbed larva increased to 1.4 cm in length.
- At this stage the larva started feeding.

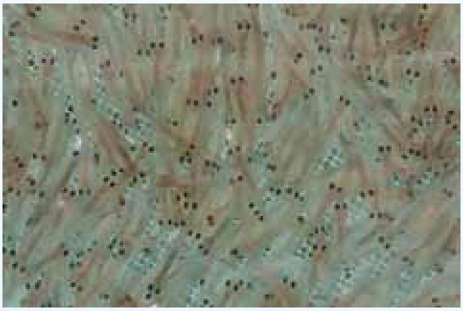
This study is an attempts to help in standardize the natural spawning and breeding technique of *Tor putitora* in controlled condition. In normal outdoor brood stock rearing ponds and cement cisterns particularly female fish will not proceed to final oocyte maturation and ovulation and subsequently undergo atrisia condition that leads to complete degeneration of ova in ovary. But in such controlled aquarium conditions female not only attain sexual maturity but also naturally spawned multiple time. This technology is a breakthrough in the field of cold water fish breeding technology Chocolate mahseer, Golden mahseer, Snow trout, Black mahseer breeding and rearing technology. These fish can breed multiple times throughout the year in confined controlled condition without use of any synthetic or stimulating hormone.

Tor putitora is a batch spawner. With good brood stock management, hatching and rearing practices, mass scale seed production of golden mahseer is possible multiple times in a year.

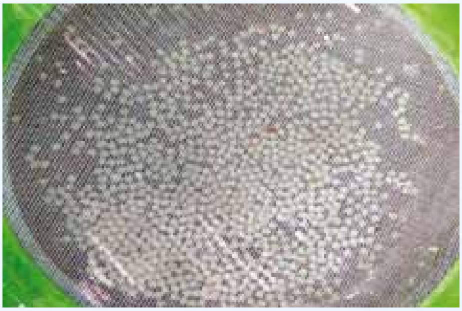
Bhimtal Lake, Natural habitat of Golden mahseer

Incubation of eggs in floating tray

Golden mahseer brood stock in Aquarium



Newly hatched hatchlings



Incubation of eggs in floating tray

(3) Indian Hill Trout, *Barilius bendelisis* (Hamilton, 1807)

Taxonomic position:

Phylum: Chordata

Class: Actinopterygii

Order: Cypriniformes

Family: Cyprinidae

Species: *Barilius bendelisis* (Hamilton, 1807),

Barilius bendelisis (Hamilton, 1807), commonly known as Indian Hill Trout belongs to the family Cyprinidae. This species distributed throughout India, Pakistan, Nepal, Bhutan, Bangladesh, Sri Lanka, Myanmar and Thailand. It is also considered as one of the principal commercial hill stream fishes in most of the streams and rivers of eastern Himalaya, Ganga region and Arunachal Pradesh. The fish mainly inhabits in shallow, cold and clear well-oxygenated water of moderate to fast-flowing rivers and streams, shallow stagnant and seasonal flowing water bodies. Morphological features of *Barilius bendelisis* is characterized by the pointed head, compressed body, blue or black vertical bands on the lateral side of body and origin of dorsal fin inserted behind the mid of the body . In captive condition they prefer well oxygenated and clean water. Fish is omnivorous and feed on phytoplankton, zooplankton, insect larvae and algae. This is a demanding food fish and has a very good potential in ornamental fish industry. This species is one of the potential candidates species for aquaculture and captive breeding in hilly areas of North East India where Indian major carps and exotic carps cannot be raised It is highly endemic as well as endangered in the rivers of Himalayan region.

Brood stock collection:

Brood stock of *Barilius bendelisis* Male average length 110-165 mm weight 13.6-18.4 g, Female average length 80-122 mm weight 6-12 g were collected from rivers Gaula (29^{O}17’25” N - 79^{O}37’43” E), Kumaon region of Central Indian Himalayas at 595 MSL. Uttarakhand during month of April -May 2016. Fish were collected using cast net in shallow river bed. The fishes were brought to the wet laboratory in oxygen filled flexible polythene tube cylinders of 50 cm diameter.

The fishes were fed *ad libitum* with commercial aquarium fish food, formulated trout feed, live food like tubifex worm and chopped goat heart.

Description of aquarium condition:

The fishes were kept in two numbers of glass aquarium tank. Each glass tank had dimension of 90x45x60cm with water holding capacity of 120-150 liters. Each glass tank was equipped with indigenously made PVC pipe under-gravel water filter that was covered with 8-10 cm thick layer of sand gravels of 3-5 mm size. The filter was operated by a power head water pump. Sand gravel act as a substrate for biological filter to eliminate the toxic ammonia generated from metabolic activities of fish, decomposition of fecal matter and excess food. Power-head water pump was continuously operated to maintain efficient water filtration system, providing continuous aeration and generating water current to simulate the water flow condition in the aquarium. Nearly 50% of the water were changed every alternate day by gravel vacuumed siphoning method for cleaning the aquarium gravel substrate to eliminate the accumulated waste materials from the gravel bed to maintain optimum water quality in the aquarium. Water quality parameter parameters in the aquarium were maintained as pH in the range of 7.2-7.8 ammonia and nitrites were nil nitrates 20-30 ppm, alkalinity in the range of 40-70 ppm, hardness in the range of 90-110 and dissolved oxygen in the range of 7-9 ppm , free carbon-di-oxide 2.0-3.2 mg/l water temperature 18-28^{0}C.

Sexual dimorphism:

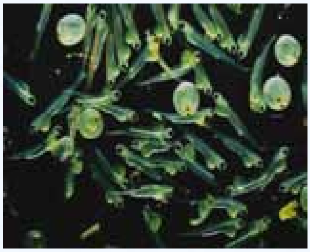
Males were observed to attain maturity earlier than females. Mature female have a swollen abdomen and comparatively smaller in size. Males have a streamlined body, look brighter and bigger in size. Mature males exude milt freely at slight pressure.

Sexual dimorphism in *Barilius bendelisis* were well developed during the breeding season. Males are brightly coloured and larger in size, having rough body. Male develop breeding tubercles on snout and head region of the body during the spawning season. Breeding tubercles were also very prominent on the body scale of the male fish. The bases of the pectoral region in front of them are highly robust. These characters are absent in females. Body scales of male tubercles contained numerous elongated spine-like structures called unculi but such structures were completely absent on the body scales of female fish. Tubercles are multicellular epidermal structures that often support a conical keratin cap. In most teleosts, breeding tubercles are more developed in males than in females. The function of these breeding tubercles is still not clear but it believed to facilitating contact between individuals during spawning. They are used by some species for defence of nests and territories and perhaps for stimulation of females in breeding. serve various roles, such as maintaining body contact during spawning or as a fitness indicator during sexual selection. Bigger and dominant male shows very prominent and large numbers of tubercles on the snout and head region of the body. Dominant males shows higher level of aggressive behavior during spawning season in maintaining their territory and breeding nest. This aggressive behavior is correlated with higher concentration of androgen and induce the formation of breeding tubercle. In the present study dominant male possess prominent and higher numbers of tubercles on their snout and operculum. Because development of breeding tubercles is contributed by androgens, this may be predicted that they should be related to the dominance status of a male. In the courtship behaviour the dominant male making quivering and butting movement against the other rival males. Butting against the female was often slightly more gentle than butting against the rival male. In this butting, the male bumped the female physically with its forehead.

Brood stock in Aquarium

Developing Eggs

A newly hatched hatchling



Newly hatched hatchlings

(4) Stripped Loach, *Schistura* spp.

Taxonomic position:

Phylum: Chordata

Class: Actinopterygii

Order: Cypriniformes

Family: Balitoridae

Species: *Schistura* spp.

Loaches which form an important group having good potential as a classified aquarium fish due to their small size, bright bands, blotches, coloration, peaceful nature, hardiness, compatibility, and which can be reared in aquarium throughout their life span. *Schistura* spp. commonly known as Loaches are the most diversified freshwater fish group belong to family Balitoridae and divided into two sub families; Balitorinae and Nemacheilinae. From the viewpoint of conservation biology, these arguments have emphasized the need for propagating *Schistura* spp. in captivity. Another strong incentive for the domestication of loaches are the need of supplying this species regularly in the aquarium fish trade as the capture from the natural environment is largely seasonal. Very limited information available on the reproductive biology and reproduction of this species. Only few attempts have been made on other species of loaches through hormonal induction technique after collecting mature brood stock from wild during breeding season. One of the major problems faced in loach breeding that in captivity condition full sexual maturity in brood fish particularly in female loaches unable to attain. Natural spawning of loach species in aquarium condition had not yet been achieved earlier. ICAR-Directorate of Coldwater Fisheries Research institute, Bhimtal has achieved a breakthrough to breed loach (*Schistura* spp.) in controlled aquarium condition without using any synthetic hormone and developed a reliable technology for the natural spawning and larval rearing of the loaches.

Distribution: In India this species have vide distribution throughout North-East India and Burma, South, Southwest and Southeast Asia, Western Ghats of India.

Habitat: The fishes of this family have a preference for water with strong current, and many species only occur in torrential mountain streams, therefore they are known as hill stream loaches.

Breeding: Most of the fishes do not reproduce spontaneously under captive conditions therefore hormonally induced breeding have become common procedure to obtain fertilized eggs under captive condition. A variety of hormonal treatments have been used in a large number of fish species, involving either pituitary hormones acting directly on the gonads or hypothalamic hormones controlling the release of gonadotropic hormones by the pituitary.

Brood stock:

Schistura spp. weighing on an average weight from 3 gm to 5 gm were collected from rivers Gaula (29°17’25” N - 79°37’43” E), Kumaon region of Central Indian Himalayas at 595 MSL. Uttarakhand during month of April -May 2016.

Description of aquarium condition:

Collected wild stock of loaches comprising of mature and sub adults were kept in two numbers of glass aquarium tanks had dimension of 90x45x60cm with water holding capacity of 120-150 liters for acclimatization and maintenance. Each glass tank were equipped with indigenously made under-gravel water filter made up of perforated 20mm PVC pipe. Pipe filters were covered with 8-10 cm thick layer of 3-5 mm size sand gravels that act as a filtration medium. The filter was operated by a electrically operated power head water pump which had a capacity to pump 1500 liters of water per hour. This allow entire volume of aquarium water passing through the filter medium 10 times in an hour. Sand gravel bed act both as a mechanical filter to trap suspended organic and inorganic particles in gravel bed and as a biological filter to eliminate the toxic ammonia generated from metabolic activities of fish, decomposition of fecal matter and excess food. Power-head water pump was continuously operated to maintain efficient water filtration system, generating water current that simulate a water current like condition in aquarium. This also helps in maintaining oxygen level near saturation level. Each glass tank was equipped with a 300 watt immersion glass aquarium water heater with thermostat to maintain uniform water temperature in the aquarium. The tank was provided with round and flat stones and terracotta pots for these fishes to take shelter.

Water quality management:

The study of the water quality parameters is very important for the rearing and breeding of *Schistura* spp.. Water quality parameter parameters in the aquarium were maintained as dissolved oxygen in the range of 7-9 ppm, free carbon-di-oxide 1.0-1.2 mg/L, alkalinity in the range of 40-70 ppm, hardness in the range of 90-110, pH in the range of 7.2-7.8, nitrates 10-20 ppm, and ammonia and nitrites were nil. Water temperature were maintained at 21-23^{0}C with the help of aquarium thermostat water heaters. Water quality parameters such as temperature, dissolved oxygen, pH and ammonia were monitored weekly.

Brood stock management and breeding:

A total of 24 fishes having average size of 300-400 mm and weight3-5g were stocked in these tanks for developing the brood stock. Every alternate day nearly 50% of the water were changed by gravel vacuumed siphon method to eliminate the accumulated waste materials from the gravel bed thus maintaining optimum water quality in the aquarium. The fishes were monitored regularly for morphological indicators of maturation. Brood stock was managed in aquarium to promote gonad development. Morphological indicators of maturation of females were known through enlarged abdomen. During maturation it was observed that males were smaller in size than females. Males matured earlier than females. The female had enlarged abdomen, which was absent in male.

Schistura spp. can be easily matured and bred successfully under captive condition similar to that of carps. It is first reported that the loach can breed in aquarium. Brood stock management and hatcheries should be established for conservation and ranching initiated for sustained natural recruitment recommended for conservation of this species. This study documents the breeding of ornamental fish *Schistura* spp. in captivity without use of synthetic hormones and embryonic and post embryonic development. Development of breeding technology to attain sexual maturity in captive controlled aquarium condition, their natural breeding without using any pituitary or hypothalamic hormones and successfully rearing of seed will prove a breakthrough in breeding and rearing technology of indigenous ornamental fish. This could contribute to conservation approach of the natural resources and to some extent to the information database. Breeding and culture of indigenous commercially important ornamental fish may be helpful in improvements in the socioeconomic status as well as financial security to the poor fishers for livelihood with limited resources. This study is useful for fish breeders, aquarium keepers and those involved in or interested in the study of fish larval and fry development.

Brood stock in Aquarium

A newly hatched hatchling

Young ones of Loach

Stripped Loach

Breeding observations: Loach, *Schistura* spp. in aquarium tanks at ICAR-DCFR, Bhimtal

(5) Dark mahseer *Naziritor chelynoides* (McClelland, 1839)

The dark mahseer, *Naziritor chelynoides* is a coldwater fish, which inhabits fast-flowing mountain streams and feeds on diatoms, algae and insects. Breeding of this fish begins from June (Menon, 2004) in wild. The species has very good potential as ornamental fish and candidate species for coldwater aquaculture. It is listed as vulnerable and critically endangered category in IUCN red list.

Taxonomic position:

Phylum: Chordata

Class: Actinopterygii

Order: Cypriniformes

Family: Cyprinidae

Species: *Naziritor chelynoides* (McClelland, 1839)

Distribution: The fish is native to streams of Garhwal Himalayas and some parts of Nepal.

This report presents the first record of natural breeding of *Naziritor chelynoides* in aquarium condition without use of any stimulating synthetic hormone at ICAR-DCFR, Bhimtal. During observation the species didn't show any distinct sexual dimorphism. Spawning behaviour and breeding habits were also recorded. First natural spawning in the aquarium was observed on 16.11.2016 and subsequently second and third spawning were observed on 10.7.2017 and 22.12.2017 respectively. It was observed that, the fish is a batch spawner and lays the eggs in gravel nest pits, where embryonic and larval development also takes place. After 4-5 days of incubation period, free swimming hatchlings were observed to be emerging from the nest.

After subsequent fertilizations the eggs were then taken out from the gravel nest pits and hatched in floating incubation trays separately in a closed re-circulatory incubation glass tank indigenously designed at the Directorate. Embryonic developmental stages were also studied. Hatchlings and fry were accepting wet feed as a first feed. No live food was given during rearing period. Seeds were successfully reared in aquarium and FRP tanks. Water quality parameters were analyzed and found at their optimum level during the entire period.

Brood stock in Aquarium

Developing Eggs

A newly hatched hatchling

Newly hatched hatchlings

Breeding observations: Dark Mahseer, *Naziritor chelynoides* (McClelland, 1839) in aquarium tanks at ICAR-DCFR, Bhimtal

4. Glimpses of Himani Aquarium at ICAR-DCFR, Bhimtal

ICAR-DCFR, Himani Aquarium

Barb species

Tetra Species

Planted Aquarium

Angel Fish

Labeo dyochelius

Gold Fish

Koi Carp


Parrot Fish


Channa spp.


Tiger Shark


Bangana devdevi


Rainbow Trout


Snow Trout


Oscar


Tin-foil Barb


Snow Trout


Golden Mahseer


Aquarium Display


Chocolate Mahseer


Visit by Dr. J K Jena, DDG (Fy), ICAR


Visit by Dr T Mohapatra, Secretary DARE & DG, ICAR

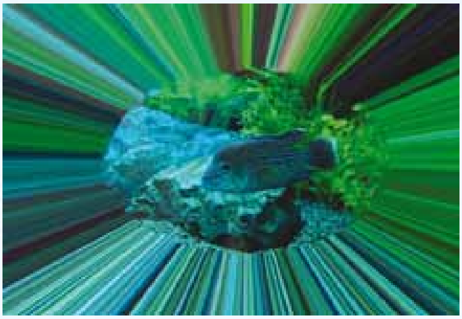

Visit by school children


Visit by Padmshree Yasodhar Mathpal

Snow Trout

Mahseer Fry

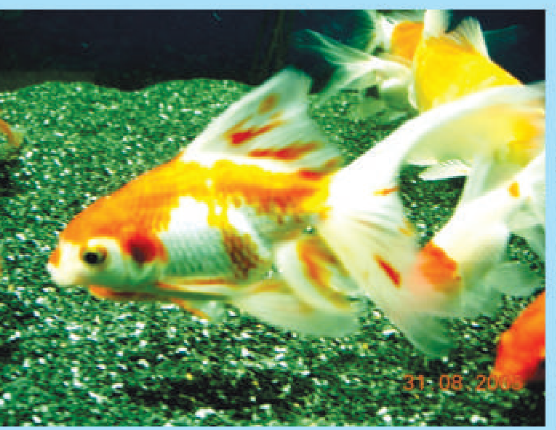
Loach Species



Cichlid Species

Banded Loach

Himani Aquarium



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