Breeding of Mahseers



INTRODUCTION

- Mahseers- one of the best game fish
- Sacred fish (God's fish) for the Hindus
- Mahseers as a sport fish that provide unparalleled recreation to anglers better than salmon (Ogale (2002))
- Important species of mahseer belong to the genus *Tor* in India. They are: Tor mahseer, *Tor tor*, Golden mahseer, *T. putitora*, Decccan mahseer, *T. khudree*, Humpback mahseer, *T. mussullah* and Mosal mahseer, *T. mosal*, Chocolate mahseer, *Acrossocheilus hexagonolepis*, *T. neilli*, *T. progenius*
- Threatened species- anthropogenic activities





Deccan mahseer, *T. khudree*

Mahseers being fed at a temple pool

• Freshwater fish, inhabit fast flowing streams and rivers of the hilly areas, optimum temperature 10-20°C

• Omnivorous, feeding on algae, crustaceans, insects, aquatic weeds and their seeds, but also fruits that fall trees overhead

• To conserve mahseer and develop sport fishing in India, the Government of India has been promoting the establishment of mahseer hatcheries in different states

 Investigations carried out by Tata Power Companies Limited (TPCO) at Lonavla, Maharashtra State, revealed the possibility of artificial propagation of mahseer (Kulkarni, 1971)

• Reliable methods are now being developed for the breeding of different species of *Tor* in India, Nepal, Bangladesh, Malaysia and Pakistan

• In India, breeding technique, with or without hormone injection has been developed for *T. khudree*, *T. putitora*, *T. tor* and hybrid mahseer

- The credit of developing technique for spawning of mahseer in captivity C. V. Kulkarni who helped establish the first mahseer hatchery at TPCO
- Nandeesha et al. (1993) were the first to achieve success in stripping and fertilizing eggs of pond-raised *T. khudree*
- The TPCO has supplied nearly 0.8 million mahseer fingerlings (as on 1994) where the fry are reared to fingerling stage and then stocked in natural water bodies to enhance mahseer stocks (Ogale, 2000)
- In addition, approximately 0.2 million mahseer fingerlings are released annually in the reservoirs owned by TPCO and the mahseer population therein has increased substantially
- The second mahseer hatchery was established at Harangi Fish Farm in Kodagu District of Karnataka, southern India, with a capacity of 1.0 million fry per year, in 1992

Broodstock care

- The maturing adults (3-5 years) are separated sex-wise in May and stocked in 400m² rectangular ponds with a soil base of about 20 cm
- Soya-based extruded feed (American Soybean Association, New Delhi) is fed to broodfish at 3% body weight daily for 2 months (July-August)
- Also feed with groundnut oil cake (25%), fish meal (25%), rice bran (25%) and rice flour (25%) at 2-3% of body weight can be given daily
- The ponds are manured once a month with cow dung (2000-3000 kg/ha) and partial water exchange is done every 15 days
- The fish is periodically checked for somatic and gonadal growth
- Wild brooders could also be for artificial fecundation.

Injection of brooders

- Two synthetic hormones, viz. ovaprim (Syndel Laboratories Canada; sGnRH-a + domperidone) and ovatide (Hemmo Pharma, Mumbai; mLHRH-a + domperidone) can induce spawning in *T. khudree*
- Identification of sex -morphological characters
- Ripe female had a soft and swollen abdomen; the male readily oozed out milt with gentle pressure on abdomen



Identification of sex of T. khudree

- Single dose of the hormone is administered intramuscularly to both male (0.2-0.3 ml/kg body weight) and female (0.6 ml/kg body weight).
- Anaesthetization of brood- quinaldine at 10 ppm for 1-2 minutes
- The injected females and males are held separately in nylon hapas (rectangular box-shaped containers) with flowing water
- The females are periodically checked for their readiness for stripping



T. khudree being injected with ovatide

Stripping operation and fertilization

- The injected females are examined every 6-12 hours following injection and the stripping operations are undertaken after the females ovulated
- This process is repeated several times till all the ovulated eggs are removed
- Males are also stripped in the same manner such that milt of one or two males is sufficient to fertilize each batch of eggs
- The motility of spermatozoa is checked prior to fertilization



Ovulated eggs being stripped on to a plastic basin

Egg incubation and hatching

- The eggs incubated at Harangi (temperature 20-23°C) and Mangalore (temperature 26-27°C)
- At Harangi, the eggs are incubated in rectangular wooden hatching trays with wire mesh at the bottom (150 cm x 20 cm x 10 cm), with running water
- Some developing eggs could be transported in 18 l capacity plastic bags with oxygen (1/3 water and 2/3 oxygen) by road (duration of journey : 6 h)



T. khudree eggs being hatched in wooden tray

• At Mangalore, the eggs are hatched in conico-cylindrical fiberglass tanks (80 l) with aeration (vortex blower)

• Important egg and embryonic developmental stages of *T. khudree* were recorded, both at Harangi and Mangalore

Fry rearing

- Carried out only at Mangalore in FRP tanks (80 l) with aeration
- The swim-up fry are fed with egg yolk (a pinch for 200-300 fry) and sieved zooplankton (50 ml zooplankton for 346 fry; each ml contained 60 numbers) twice daily, morning and evening
- Continued for 14 days after which the fry were transferred to 25 m² manured concrete ponds at a stocking density of 0.1 million/hectare
- In ponds, the fry are fed *ad libitum* with a feed containing fishmeal (25%), ground nut oil cake (25%), ragi flour (25%) and chicken egg yolk (25%) for 53 days



20-day-old T. khudree fry

- *T. khudree* batch spawner
- The colour of freshly stripped eggs of varied from bright orange in farm-raised fish to pale orange in wild caught females
- The developing good eggs orange or lemon yellow in colour; unfertilized eggs opaque white and were periodically removed from the trays with a filler
- The fertilization rates -77-100%
- The dry method of fertilization better than the wet method
- The freshly stripped spermatozoa showed a motility rate of 95-100% and duration of 1-2 minutes when activated with tap water
- The egg and embryonic developmental stages proceeded normally, but at a slower rate at Harangi and faster rate at Mangalore

Egg and embryonic stage	Hours after fertilization	
	<u>At Harangi</u>	At Mangalore
 Blastodisc formation Morula stage Blastula stage Gastrula stage Yolk-plug stage Embryo indication Pea-shaped embryo Twitching movement Moderate twitching Vigorous twitching Hatching started Hatching completed 	2 5 13 18 27 37 48 55 63 70 80 112	- 4-5 10 - 22 - - 33-34 55 62 63 70

- The hatching periods were 80-112 and 61-70 hours at Harangi and Mangalore, respectively
- The proportion of deformed fry was also higher at Harangi than that observed at Mangalore
- Fungal growth on eggs controlled by dipping eggs in a solution of KMnO₄ (3-5 ppm) for 5 minutes
- The length of newly hatched farm raised fry was 7.4 mm (+/- 0.55). By 37 days, the fry attained a length of 5.63cm and a weight of 2.03 mm
- The wild fry reached 22.7 mm (+/-2.19mm) after a rearing period of 20 days
- By the 67th day, the hatchery fry grew to 80.8 mm (weight: 6.39 g), while the wild fry attained 64.1 mm (weight: 3.02 g)

- The first mahseer hatchery in India TPCL at Lonavla in Maharashtra State and the credit goes to C. N. Kulkarni
- The second mahseer hatchery Harangi Fish Farm in Kodagu District of Karnataka, with a capacity of 1.0 million seed per year
- Later, the National Bureau of Fish Genetic Resources (NBFGR), located at Lucknow, Uttar Prudish, standardized technique for large scale production of mahseer fry in Uttarakhand State using the method adopted by TPCL, Lonavla
- Subsequently, the Department of Fisheries of Uttarakhand established two mahseer hatchery units, one at Dehradun and the other at Bhimtal
- Recently, the Jammu and Kashmir government constructed a mahseer hatchery at Anji near Salal Hydel Project with a capacity to hatch 1.0 million eggs per year
- Very recently, the Government of Kerala established one hatchery at Malampuza and the Government of Tamil Nadu has just sanctioned one mahseer hatchery which is coming up at Salaiyar Dam in Coimbatore District, under Western Ghat Development Programme

SEED PRODUCTION OF TROUTS



- Trouts belong to the family Salmonidae and Order Salmoniformes
- Among trouts, the rainbow trout, *Oncorhynchus mykiss* is the most important species.
- Other species of trouts are : brown trout (*Salmo trutta fario*), brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*), etc.
- Trouts native to India are : snow trouts (*Schizothorax* spp.)



Figure: Rainbow trout, Oncorhynchus mykiss



Figure: Snow trout, Schizothorax spp

Habitat and biology of rainbow trout

• Rain bow trout- native to North America

- It is a hardy fish, Easy to spawn Fast-growing, reaching 5-10 kg in 3 years, with anadromous (steelhead trout) growing faster (7-10 kg)
- Tolerant to a wide range of environments and handling
- Large-scale fry production is possible as they prefer to feed on zooplankton
- It is anadromous as well as purely river or lake resident (spends entire life in river or lake)
- Can tolerate 0-27°C, spawning and growth occur at 9—14°C.

Identifying characters:

- Fusiform body with 60-66 vertebrae, 3-4 dorsal spines, 10-12 dorsal soft rays, 3-4 anal spines, 8-12 anal soft rays, 19 caudal rays
- Adipose fin presentwith black edge
- Coloration blue to olive green above a pink band along the lateral line and silvery below

Food and feeding:

- Adults feed on aquatic and terrestrial insects, molluscs, crustaceans, fish eggs, minnows and small fishes
- Juveniles are omnivorous
- Freshwater shrimps when fed to trouts supply carotenoid pigments which imparts orange coloration





Figure: Trout feeds and feeding

Brood-stock development:

- RBT spawn during spring (January-May)
- Photoperiodic manipulation can advance or delay maturation and spawning which ensures year-round fry production
- It does not spawn naturally captivity and in aquaculture systems
- Eggs are artificially obtained by spawning or stripping females
- Ripe/fully mature females (3-4 year-old) fish is preferred
- High quality broodstock is used
- More number of females is required as fecundity is low

- Females produce up to 2,000 eggs /kg body weight
- Eggs are large (3-7 mm)
- Sex ratio 1 : 3 (male and female) are kept separately prior to spawning
- Since broodstock development is costly, eggs are seldom purchased and hatched.
- Disease-free eggs are purchased. But they should be treated with iodine at 100 mg/l for 10 minutes
- All-female triploid (sterile) trout produced through gynogenesis and triploidy and all-female progeny produced through 17α - MT treatment and selective breeding are also used for grow-out farming.

Stripping and fertilization:

- Sex of broodfish is identified based on secondary sexual characteristics which are more pronounced during breeding season.
- Females are slightly larger and have swollen abdomen
- Males are slightly smaller and have round abdomen
- Stripping and fertilization technique is well-developed
- Dry method of fertilization is a common approach





Figure: Race ways where trout brooders are reared

- No hormones are used for spawning in this species.
- Eggs are stripped on to a clean basin and mixed with milt from more than one male to ensure better fertilization and reduce inbreeding.
- Fertilized can be transported after 20 minutes and up to 48 hours after fertilization, but then not until the eyed-stage.
- Exposure of eggs to direct sunlight should be avoided





Figure: Developing trout eggs

Hatching

- Eggs incubated undisturbed until the eyed-stage, in hatching troughs, vertical incubators or hatching jars.
- Hatching and rearing troughs are 40-50 cm wide, 20 cm deep and up to 4 m in length.
- Two layers of eggs are placed in wire baskets or screened trays.
- Water flow rate is 3-4 l/minute.
- As the eggs hatch, the fry drop through the mesh to a bottom trough.
- Some times up to 16 trays are stacked one above the other.

- Hatching period is 100 days at 3.9°C or 21 days at 14.4°C.
- Dead eggs are periodically removed to limit fungal attack.
- Fugal infection is controlled using formalin (37% solution of formaldehyde) for 15 minutes.
- Hatching rate is up to 95%.
- Yolk-sac absorption period lasts for 2-4 weeks.
- After hatching, the trays are removed and trough water depth is maintained at 8-10 cm until swim-up stage
- After yolk-sac absorption, the fry actively actively search for feed.

Fry rearing

- Fry are traditionally reared in fiberglass concrete tanks (circular ones preferred).
- Diameter of circular tank is 2 m or size of squarish tank is 2 m x 2 m, with 50-60 cm depth.
- The drain is fixed in the centre of the tank and is protected by a mesh screen.
- Fry are fed with specially prepared starter feeds using automatic feeders.
- Feeding rate is 10% b.w. daily for 2-3 weeks using continuous feeders
- Feed pellets contain fish meal (80%), fish oil and grains.
- Feed contains proteins (50%), fat (12-15%) and vitamins (A, D and E), minerals and pigments (astaxanthin and canthaxanthin).

Water quality requirements

- DO : near saturation
- CO₂ : < 2 ppm
- Temperature : 12-21^oC
- pH : 6.5-8.5
- Alkalinity : 10-400 ppm (as CaCO₃)