

## **SEMESTER -2**

### **C4T**

#### **Breeding and Hatchery Management**

##### **Selection of riverine fish spawn collection sites, gear used and methods of collection:**

The Central Inland Fisheries Research Institute (CIFRI) located at Barrackpore, Kolkata, during 1959 – 1964, conducted a pioneering program of seed prospecting investigations on various river system with a view to ascertaining the quality and quantity of fish seed, availability, gears for spawn collection, method of collection, measurement of fish seed, factors responsible for fluctuation in seed availability, etc. on an all-India basis.

The diverse geographical and climatic conditions of India greatly influence riverine resources of the country.

The most important carp seed resources are: eggs, spawn, and fry and fingerlings.

##### **Selection of spawn collection site:**

Before selecting a suitable site for the collection spawn in a given stretch of river, a pre-monsoon survey is conducted to ascertain:

1. Topography of the terrain and bank features at the vicinity of the site.
2. Topography of dry bed and bank features.
3. The distribution and composition of fish fauna.
4. The location of tributaries, rivulets and ‘nallahs’ and their confluence with the main river.
5. The identity and accessibility of the site.

##### **Induced breeding:**

The breeding technique in which the breeders use hormones to ripe the fish artificially is known as induced breeding.

This leads to the release of eggs and sperms from the fish at a specific time interval.

As induced breeding is an artificial technique it is also known as artificial breeding.

The hormone used during induced breeding is gonadotrophin.

Gonadotrophin comprises that follicle-stimulating hormone (FSH) which induces early gametogenesis in fish.

##### **Broodstock management:**

Broodstock, or broodfish, are a group of mature individuals used in aquaculture for breeding purposes. Broodstock can be a population of animals maintained in captivity as a source of replacement for, or enhancement of, seed and fry numbers. These are generally kept in ponds or tanks in which environmental conditions such as photoperiod, temperature and pH are controlled. Such populations often undergo conditioning to ensure maximum fry output. Broodstock can also be sourced from wild populations where they are harvested and held in maturation tanks

before their seed is collected for grow-out to market size or the juveniles returned to the sea to supplement natural populations. This method, however, is subject to environmental conditions and can be unreliable seasonally, or annually. Broodstock management can improve seed quality and number through enhanced gonadal development and fecundity.

Broodstock management involves manipulating environmental factors surrounding the broodstock to ensure maximum survival, enhance gonadal development and increase fecundity. Such conditioning is necessary to ensure the sustainability of aquaculture production, and to increase the number and quality of eggs produced and control the timing of maturation and spawning. Management of the technologies for gamete production in captivity is one of the essential steps for aquaculture that would ensure the growth of this sector. Unfortunately, most fish when reared in captivity conditions, exhibit some degree of reproduction dysfunction. Many species of captive fish are able to reach reproduction maturity in aquaculture conditions and gonadal growth occurs normally. However, some of female species often fail final oocyte maturation stage. Hormonal manipulation and acceleration of final oocyte maturation due to the economics of broodstock management is important.

#### **Importance of broodstock management:**

- Broodstock management is important because proper brood fish management gives quality egg and sperm.
- Broodstock management is one of the most important parts of aquaculture and ensures successful aquaculture.
- Proper broodstock management decreases the larval or fry mortality and increases production and gives huge amount of stronger and disease free fry and larvae.
- If the brood fishes are properly managed, it will remove the inbreeding problem.
- Proper brood fish management is the key to success of induced spawning.
- Proper brood fish management increases the fecundity of egg and sperm and also gives rapid growth of larvae, fry at first and later the fishes.
- By proper management of endangered brood fishes, it is possible to save endangered fish from extinct.
- Brood fish management gives the supply of fry, larvae at appropriate time and at low cost.

#### **Cryopreservation:**

Cryopreservation is the technique by which living things (cells, tissue, gametes) are preserved viable for an indefinite period by storing them at an ultra-cold temperature (-196 °C). At this temperature, the metabolic activities of the cells are arrested, but they remain viable. Their normal functions can be reactivated after proper thawing. The cryopreserved semen of improved strains of fishes are also nowadays used for the purpose of selective breeding and hybridization.

#### **The objectives of cryopreservation of fish gametes are:**

For long-term preservation of desired gametes for future use.

For conservation of endangered species and preservation of genetic diversity by making gene bank.

For improvement in induced breeding, hybridization and selective breeding.

To curb the problem of asynchronous maturity time in males & females during artificial breeding.

For interbreeding of different stock/ species maturing at different time/ seasons. For easily transportation of gamete to different areas. In the case of seasonal breeders such as major carps, seed can be produced and supplied to farmers at any time of year as per the market demand.

It helps in the development of selective breeding, hybridization, induced breeding and other techniques meant for genetic up gradation of cultivable fishes aimed at generating a superior strain that shall exhibit faster growth rate, better disease resistance better adaptability to extremes of climates and better feed conversion efficiency.

It can help in preventing inbreeding depression.

It can reduce the cost of male broodstock maintenance through the exploitation of limited stock

#### **Cryoprotectants:**

The cryo-injuries can be prevented or reduced by certain protective chemicals called cryoprotectants and diluting solutions called extenders. The cryoprotectant helps to avoid or minimize the process of formation of a crystal in the intracellular fluid. An ideal cryoprotectant should be permeable, soluble and least toxic to the cell. **Function of a normal cryoprotectant:**

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1. Reducing the rate of diffusion of water from cell to extracellular ice crystal.
2. Reducing the cell volume change.
3. Reducing the rate of ice crystal growth.
4. Lowering the homogeneous nucleation temperature.

#### **Parental care:**

Many species of fishes do not care for their eggs and fingerlings. They leave the spawning grounds after fertilization. For such species of fishes the lacking parental care behaviour is compensated by the production of large number of eggs. Such fishes lay over 300 million eggs at a time.

The cod fish lays over nine million eggs which are scattered at random in the open sea. Carps lay two to four million eggs at random in fresh water and adjoining aquatic vegetation. It has been estimated that about 77 per-cent fishes show no parental care, another 17 percent of the fish species care for the eggs only, while less than 6 per cent care for eggs and newly hatched young.

#### **Fishes that produce limited number of eggs have evolved various grades of parental care behaviour:**

##### **A. Depositing Eggs in Suitable Places:**

A number of fish species have developed some design of depositing their eggs in suitably protected places. They do not build nests.

##### **(a) Deposition of eggs in sticky covering:**

(i) In carps, eggs are usually laid with some special sticky covering by means of which they are attached to each other or to stones, weeds etc.

(ii) In yellow perch (*Perca flavescens*) eggs are deposited in a rope-like structure. The eggs are held together by a long floating membrane.

(iii) Angler fish (*Lophius*) lay their eggs invested by a gelatinous external coat, that remain together to form a transparent mass of enormous size .

(iv) Flying fishes, skippers, garfishes etc. secrete a sticky thread-like substance from their kidney, on which the eggs remain attached . The thread on one end remains adhered to any aquatic substratum while the other end remains free.

**(b) Eggs scattered over aquatic plants:**

Eggs of fishes such as pikes (*Esox lucius*), carps (*Cyprinus carpio*), *Carrassius auratus* etc., are scattered over aquatic plants to which they remain attached.

**(c) Eggs layed at suitable places:**

(i) Anadromous fishes (lives in the sea but migrates to fresh water for breeding) such as *Salmo solar*, *Acipenser*, *Oncorhyncus* etc., lay their eggs in suitable spawning grounds. They dig excavation in gravel substrate, lay their eggs in the pits, cover them with gravel and desert them.

(ii) Sand Gobi (*Pomatoschistos minutus*) lay their eggs in some protected place, where they are guarded by the male who also aerates them by his movement.

**B. Deposition of Eggs Into Self-Made Nest:**

Some species of fishes prepare nests of different types for the safe deposition and protection of eggs, and for the development of their young ones. In the building of the nest, only the males or both sexes participate. Various kinds of materials such as pebbles, aquatic vegetation, secretion of their body etc., are used for nest formation.

**The different types of nests built are:**

**(a) Basin-like nests:**

(i) Male of Darter (*Etheostoma congregata*), during the spawning season, selects a suitable place called domain, which it defends repelling with vigour any attempt by rival males. Any female Darter entering its domain is allowed to remain.

The female Darter then makes a basin-like depression, sinks into it and deposits the eggs. The eggs are immediately fertilized by the male who covers the fertilized egg by a sticky secretion, secreted from its kidneys. These sticky eggs remain attached to the stone till hatching.

(ii) Fresh water sunfishes build a nest by scooping out a shallow basin-like nest at the bottom of the impoundment by carefully removing pebbles and leaving behind large stones . A layer of fine sand remains attached with the eggs. Male sunfish guard the eggs till they hatch.

### **C. Concealing Eggs and Young's in or on their Body:**

Certain species of fishes have developed many structures in their body to safeguard the eggs and young ones:

#### **(a) Eggs and young's concealed in mouth cavity:**

(i) In many cichlids (Example: Tilapia), the female broods the fertilized eggs in her mouth (Fig. 5.46A). After hatching she allows the young to take refuge in her buccal cavity in times of danger.

#### **Breeding season for fish in India:**

The fisheries department has declared April, May and June as breeding season for marine life including fish in the Bay of Bengal, Gulf of Mannar and Palk strait. However, traditional country boats which operate near the coast are allowed to fish during the season.

#### **Multiple spawning :**

- Refers to spawning fish, female in particular, more than once in a season
- This is particularly important in carps as they have narrow captivity breeding season and are difficult to bring them to maturity to maturity in captivity. • Resulted in the successful spawning of major carps up to four times in a season.

#### **Factors that facilitate multiple spawning of carps are :**

1. Manipulation of water quality
2. Manipulation of diet
3. Use of ready-to-inject spawning agents
4. Use of circular spawning and hatching tanks