Editorial

A Happy New Year to all NTAS members. This first issue of 1994 has a mixed bag of interesting articles (carps, catfish and crabs) and a variety of news items and a few letters, but is smaller than it should be. This is largely because some authors are not responding quickly to communications regarding the editing or revision of their submissions. We have a backlog of papers awaiting authors' comments and revisions. Moreover, with such a large NTAS membership (473 members in 79 countries), our mailbox should be bursting with interesting items and photos to publish. Sadly, it isn't. New Year's resolutions could improve this? Please send more and please respond rapidly to correspondence.

In this issue, we are also publishing a thesis abstract from a member and may make this a regular feature. The abstracts from theses of NTAS members should be of interest to others. Please let us know what you think of this idea and please send copies of abstracts from recently accepted theses (M.Sc. and Ph.D., 1993 onwards) for possible publication. ***R.S.V. Pullin***

Carp Seed Production in Karnataka, Southern India, with Special Reference to Rearing Larvae in Reservoir-Based Pens

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Introduction

India has vast freshwater resources: about 1.6 million ha of ponds and other inland waterbodies called 'tanks.' Less than 50% are presently utilized for aquaculture. Inadequate supply of fish fingerlings is the major constraint for aquaculture and reservoir fisheries development. India's current annual fish seed production is around 13,500 million: less than 50% of the requirement. About 25% of the total freshwater resources of the country are located in the southern state of Karnataka which produces over 135 million fish fingerlings annually, against a requirement of about 800 million. There are about 25 government-controlled fish seed production and rearing farms in this state, but only 50% are active. Attempts are now being made to increase the productive water area of these farms. A couple of private fish seed production and rearing farms have recently become operational.

Indian freshwater aquaculture is based mainly on the polyculture of six species of carps: Indian major carps – catla (*Catla catla*), rohu (*Labeo rohita*) and mrigal (*Cirrhinus mrigala*); and exotic carps - silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*). However, this species combination is not strictly adhered to owing to nonavailability of fry, consumer preferences, etc.

Constraints to Seed Production

The following constraints apply to carp seed production in Karnataka:

- *Restricted spawning season* - Five of the six carp species (common carp being the exception) breed naturally only from June to September in flooded rivers, and do not spawn in confined waters like ponds and tanks. They have to be induced to breed in captivity within the natural breeding season by injecting crude extracts of fish pituitary glands (practised since the late fifties). Irregular monsoon rains often limit the seed production targets.
- *Poor broodstock husbandry* - Most breeders feed broodstock with a mixture of groundnut oil cake and rice bran, which is not nutritionally adequate for production of healthy fry and fingerlings. Only a couple of seed farms use a special broodstock feed (rice bran, groundnut oil cake, horse gram, black gram, fishmeal, soyabean flour, sorghum, and vitamins and minerals) which is nutritionally superior and results in increased fecundity and seed quality and advances maturation and spawning by one or two months.
- *Inbreeding* - There is now a genuine fear that Indian major carps have become inbred at most hatcheries (Eknath and Doyle 1990), leading to reduced growth, decreased reproductive performance, increased susceptibility to diseases and morphological deformities. Most fish breeders raise their own broodstock and do not collect wild seed or seed from other fish farms for breeding purposes. Relevant information on exotic carps is lacking.
- *Shortage of induced spawning materials* - Most hatcheries use carp pituitary glands (dosages 2-3 mg/kg for males and 5-8 mg/kg for females) supplied mostly from Calcutta, but supply is often inadequate and the preparations are of varying potency due to the cumbersome methods of collection, preservation, processing and adulteration. Marine catfish (*Tachysurus* sp.) pituitary glands are also being used but the dosages required for successful spawning are almost double those of carp pituitary. Human chorionic gonadotropin (HCG) is rarely used in Karnataka as it has often not

been successful in inducing spawning in Indian major carps. Some farms use a very low dose of HCG (6-7 mg/kg) for females only for advancing maturation to facilitate induced spawning by the end of April. Several fish breeders in Karnataka inject ovaprim, an analog of salmon gonadotropin-releasing hormone (Syndel Laboratories, Canada; marketed by Glaxo India Ltd.) plus a dopamine antagonist to females (0.5 ml/kg) and carp pituitary extract to males (4 mg/kg) as opposed to the recommended dose of 2-3 mg/kg. Ovaprim is convenient to use (supplied as a solution) and gives consistently good results which compensate for its cost. For example, a net profit of Rs963 can be derived per kilogram of ovaprim-injected broodfish, compared to Rs678 for pituitary-injected broodfish (Nandeesha et al. 1990) (US$1 = Rs32).

- *Poor hatchery water quality* - Most hatcheries neglect water quality requirements, hence fertilized eggs, larvae and fry suffer mortality, due especially to low dissolved oxygen and high suspended solids. Several farms use Chinese-style circular systems with running water for hatching eggs. These give high hatching rates (90-95%) but require large amounts of water. The process of separation of egg shells from larvae is cumbersome.
- *Poor nursery practices* - Three-day-old postlarvae normally accept natural or artificial feeds and can be transferred to nursery ponds where predatory fishes and insects, algal blooms and poor water quality are major causes of mortality. Most seed farms attempt to control these, e.g., by applying mahua oil cake to eradicate unwanted fish prior to stocking; by applying soap-oil emulsion and subsequent netting to remove insects; and controlling algal blooms by duckweed (removed once the bloom disappears). Feed made from rice bran and groundnut oil cake is commonly given to nursery ponds stocked at 2-10 million/ha but this should be improved; inferior water quality also leads to high mortality (survival of carp fry in nursery ponds does not normally exceed 30%).
- *Seed transportation* - Carp seed are commonly transported by road in 18-l capacity high density polythene bags containing 1/3 water and 2/3 pure oxygen, sealed and packed in rectangular metal boxes. Before packing, larvae are kept overnight in hapas or cement cisterns to void their gut contents. The number of seed to be packed in each bag depends upon their size [from 2,000 to 10,000; 600 to 700; and 150 to 200 for larvae (<8 mm), fry (8-40 mm) and fingerlings (40-150 mm), respectively] and the duration of transport. Farmers do not strictly adhere to this definition and to the recommendation of the National Fish Seed Committee. Many times they sell fry as fingerlings and vice-versa.

Rearing of Carp Seed in Pens Erected in Reservoirs

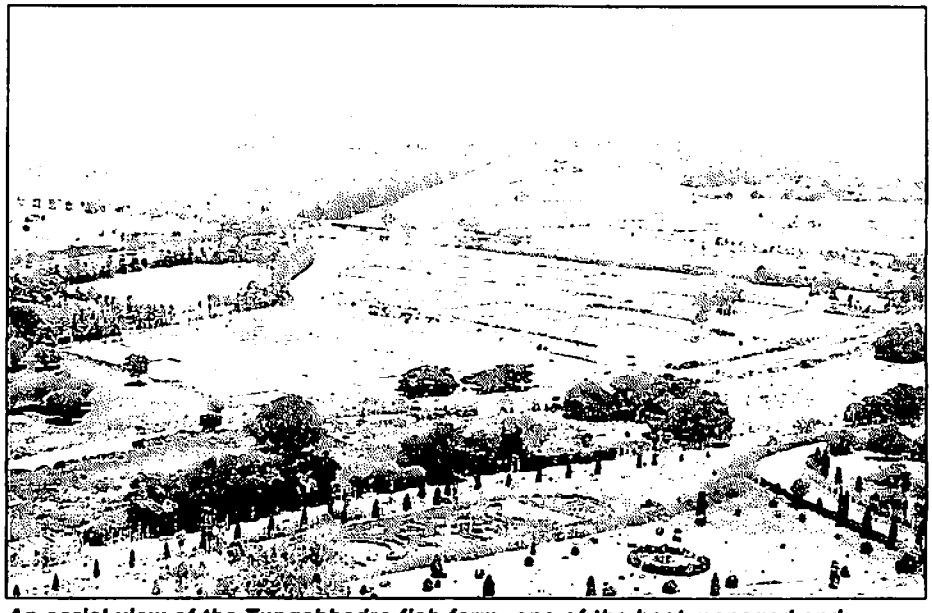
Background

Carps are generally farmed in ponds with little water exchange. The alternatives are cage and pen systems. These can be used for rearing larvae, fry and fingerlings. Cages and pens in flowing waters can enjoy an abundant supply of oxygen, flushing of metabolic wastes of the stocked fish, and nutrients from the catchment area. Growout of fish in cages is well-known in the IndoPacific region, but the rearing of fish seed in pens, located in running waters, has not been widespread.

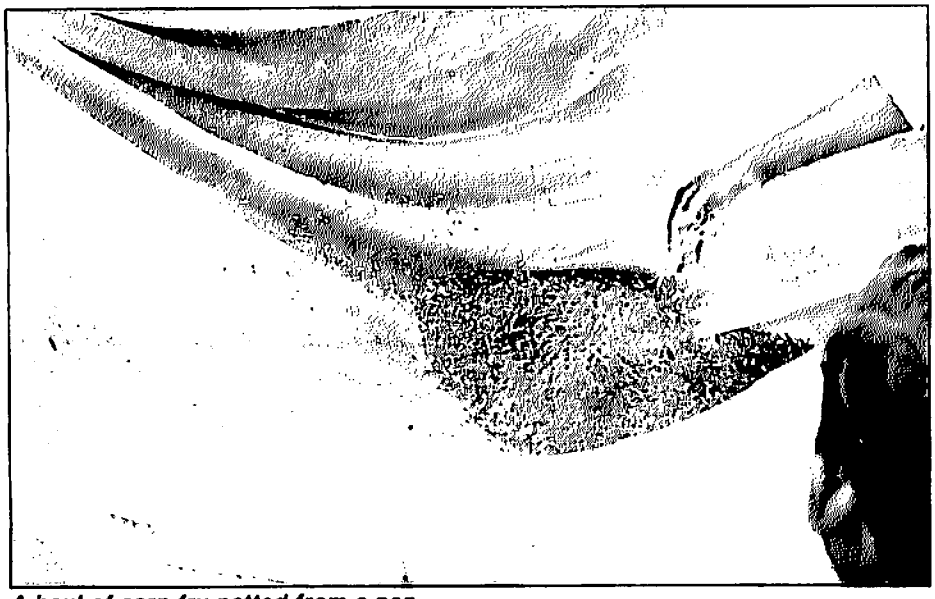
The Tungabhadra Reservoir

In India, there were attempts by the Central Inland Fisheries Research Institute (CIFRI) in this state and elsewhere to rear carp seed in floating cages made from synthetic fabrics. The results were not promising. Rearing of larvae in pens made from locally available materials was tried for the first time in Karnataka in the Tungabhadra reservoir by the Tungabhadra Board which has one of the best managed and largest fish seed farms in south India. In the early 1980s, initial trials were made to establish pens on the periphery of the reservoir (Swaminathan and Singit 1982). The main objective was to nurse the delicate carp larvae in pens up to fingerling stage and then stock them in the same reservoir in order to improve the fish landings and boost the socioeconomic status of fisherfolk. Since then, the practice of raising carp spawn up to fingerlings has become well-established on a large scale.

Tungabhadra reservoir has a maximum water area of 37,814 ha and offers vast scope for fish production. It produced 24 t in 1954-55 and 4,200 t in 1981-82: mainly catfishes, minor carps, minnows,



An aerial view of the Tungabhadra fish farm, one of the best managed and biggest fish seed farms in south India.



A haul of carp fry netted from a pen.

A truck being loaded with rectangular tin boxes containing carp seed destined for transportation.

etc. With the release of pen-reared carp fingerlings starting from 1982, Indian major carps, which were not formerly part of the catch, now account for nearly 60% of the total catch (6,000 t).

Selection of a suitable site, normally away from the main dam or barrage, is the most important aspect for the successful rearing of fish seed in pens. In Tungabhadra reservoir, the sites are around 67 km away from the dam. An ideal site will generally have a gentle slope with red loamy soil where water remains for a period of 2-3 months between August and November. The site should be well protected from wind and wave action by small hillocks surrounding the area. In the vicinity of pens, a shed is constructed as a guardhouse and for storing feed ingredients.

A pen is normally made up of casuarina poles, 2 m high, fixed at intervals of about 1.2 m, enclosing an area of 2,000 to 5,000 m^2. Between the vertical poles, three horizontal rows of split bamboo strips are tied to give support for the net material. Close mesh (monofilament nylon fabric, 30 mesh) having a width of 1.5 m is used as the pen wall material. The bottom of the nylon fabric is inserted firmly into the mud and the vertical part securely tied to the poles and bamboo strips. Pen preparation starts 15-20 days before the dam reaches its full level. After establishment of pen, the enclosure is limed, fertilized with cattle dung and treated with soap-oil emulsion. The water in the pen is about 1.0-1.2 m deep. The pen is then stocked with three-day-old major carp larvae (4-5 million/ha), produced in the adjacent fish seed farm, fed thereafter with a mixture of groundnut oil cake and rice bran at a ratio of 1:1, from a boat. In addition, the pens are periodically manured with organic and inorganic fertilizers to sustain production of zooplankton. There is a basal application of 10,000 kg cow dung, 400 kg urea and 100 kg superphosphate per ha, followed by repeated applications, at 10% of these rates, every two or four weeks.

Survival to 70-80 mm fingerlings is as high as 60% after three to four months. Periodic sampling is done to monitor growth and adjust the feed quantity.

The fingerlings thus grown are stocked in the same reservoir to enhance major carp production. Fishing licences are given to local residents to uplift their socioeconomic status. Although the pen construction is simple, easy, less expensive and efficient for the nursery rearing of carp fry, one drawback is the shortage of foreshore area for large-scale pen operation.

The Future

The lack of carp nursery areas and poor breeding strategies are largely responsible for the chronic shortage of fingerlings in Karnataka state. With a blue revolution being realized in the neighboring state of Andhra Pradesh, where more than 50,000 ha of ricefields have been converted to carp and shrimp farms over the last five to six years, more entrepreneurs of Karnataka (5 to 10 each year) are venturing into fish seed production, which is highly profitable. With the adoption of innovative methods, like pen rearing, the wide gap between the carp seed supply and demand requirement is expected to narrow, thus leading to higher fish production.

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