COMMON CULTURE PRACTICES FOR CYPRINIDS IN ASIA

Tarlochan Singh

INFOFISH, 50728 Kuala Lumpur, Malaysia

Abstract. Cyprinids are the largest group of cultured freshwater fish and thus the most important from the aspect of fish-borne parasitic zoonoses. The common practices employed in the culture of this group are described to provide background information which may be used in the formulation of strategies for the control of these zoonoses. Only the common carp is cultured in monoculture; all the rest of the carp species are usually cultured in polyculture systems incorporating several species. Polyculture of cyprinids may be carried out in ponds, cages or in free range culture in natural or man-made water bodies, Polyculture of cyprinids is often integrated with agriculture, such as livestock, poultry or crop farming, utilizing byproducts of the agriculture activity, especially manure, as a source of nutrient for the fish pond. If precautions are not taken, this practice may provide an avenue for the transmission of fish borne parasites to man.

INTRODUCTION

Of all the species of finfish or shellfish used for aquaculture, cyprinids have the oldest history. The common carp, *Cyprinus carpio*, has been introduced into so many regions of the world that it is now considered a 'universal' species. It is probably one of the few aquaculture species that can be considered to be truly domesticated.

Among the other species of cyprinids commonly cultured in Asia are the so-called Chinese carps: the grass carp *(Ctenopharyngodon idella)*, the bighead carp *(Aristichthys nobilis)*, the silver carp *(Hypophthalmichthys molitrix)*, the black carp *(Mylopharyngodon piceus)* and the mud carp *(Cirrhinus molitorella)*.

Another group of carp is the Indian carp, the major species of which are: catla *(Catla catla)*, rohu *(Labeo rohita)*, mrigal *(Cirrhina mrigala)* and calbasu *(Labeo calbasu)*. There are many other minor species of carps such as the goldfish *(Carassius auratus)*, the hoeven carp *(Leptobarbus hoevenii)* and the Javanese carp *[Barbodes (Puntius) gonionotus]*.

FOOD AND FEEDING HABITS

The carps have a wide range of food and feeding habits. The common carp is an omnivore and feeds on a variety of plant and animal matter. When young it feeds on protozoa and zooplankton such as copepods and cladocerans; as they grow older they begin feeding on benthic organisms such as insect larvae, worms and molluscs, together with large quantities of vegetable matter and epiphytic organisms.

The grass carp is herbivorous and feeds on macrovegetation including grass and aquatic plants. The silver carp is planktivorous, feeding mainly on phytoplankton. The bighead carp consumes macroplankton while the black carp feeds on snails and other molluscs on the pond bottom. The mud carp feeds primarily on detritus.

Among the Indian carps, catla is considered to be a surface and column feeder. Its feeding habit changes as it grows: during the larval and fry stages it feeds on planktonic unicellular algae, gradually changing its preference to zooplanktonic organisms such as protozoans and crustaceans until it becomes an adult when it prefers different types of algae, planktonic protozoa, rotifers, crustaceans, molluscs and decaying macrovegetation.

The rohu is a column feeder; larvae and fry feed on unicellular algae and zooplankton while adults feed on various types of vegetable matter including decaying aquatic plants and algae. The adult mrigal is a bottom feeder foraging on algae, diatoms, higher plants and dertritus; the larvae and fry are planktivorous like the other Indian carps.

The calbasu is also a bottom feeder, feeding on benthic and epiphytic organisms and organic debris; the larvae and fry feed on unicellular algae until they reach a size of 2 cm after which they prefer phyto and zooplankton.

SPAWNING AND FRY PRODUCTION

At one time the culture of Chinese and most Indian carps was dependent on the collection of eggs, larvae or fry from natural spawning areas. With the development of induced breeding technics, most cyprinid fry used for aquaculture is now produced in spawning ponds or hatcheries.

The common is the only important carp species which spawns naturally in captivity. All the other species need hypophysation technics involving the injection of various substances into selected brood fish to induce gonadal maturation and spawning. Such hypophysation technics are also used for the common carp when conditions are not favorable for natural spawning.

The inducing agents commonly used are extracts of the pituitary gland of the common, bighead or silver carp, human chorionic gonadotrophin (HCG), luteinizing release hormones (LRH) or analogues of luteinizing release hormones (LRHa). The efficacy of the inducing agents vary with particular species and so does the dosage. The inducing agents are injected intramuscularly or intraperitoneally.

Following hypophysation the fish are either allowed to spawn naturally or the ripe eggs and milt are stripped manually and mixed for fertilisation to occur. The eggs are then incubated until they hatch after which the larvae are reared in tanks or hapas. Usual larval feeds are planktonic organisms like mocroalgae, rotifers, ciliates, etc.

As the fry grow, they are transferred to special nursing containers (*eg* tanks, small ponds, troughs, cement cisterns). Zooplankton of the right size are the most efficient food at this time. It is also advisable to provide artificial fry feeds to obtain rapid growth. A common fry feed is made of yeast (40%), blood meal (25%), fermented and predigested soya (20%), fine quality fish meal (10%) and soya oil (5%), all finely ground and sieved through suitable sized mesh. Although the nursing period varies considerably, the most common practice appears to be to grow the fry in the nursery for about a month before transferring them to growout ponds.

GROWOUT CULTURE

Carps are almost always grown in polyculture where the varied feeding habits of the various species of carps are used for optimum utilization of the various niches (surface, column and bottom) of the culture pond environment. The polyculture could involve various species of Chinese and/or Indian carps. Sometimes the carps are grown in polyculture with other fish such as tilapia, grey mullet, catfish, etc. The common carp is probably the only important cyprinid species which is grown in monoculture.

Cyprinids can be cultured in earthen ponds; lakes, mining pools or reservoirs (either in free ranging culture or in fixed or floating net-cages); concrete tanks or raceways, or in integrated agriculture-aquaculture systems with crops, poulty or livestock. In most of these systems, especially those involving polyculture, feeding of the cultured fish is achieved by boosting the natural productivity of the water body through the addition of organic or inorganic fertilizers. In intensive culture, as in the monoculture of the common carp, commercially prepared formulated feeds are also used. The salient features of the main culture systems are described below.

(a) Carp monoculture

A specialized type of carp monoculture is practiced especially in Indonesia and Japan for the intensive culture of common carp. Small concrete ponds or raceways, ranging in size from 15-100 m^2 with a water depth of 0.8-1.2 m are used. The water source is a stream or irrigation canal and the water exchange rate in the pond is very high (about 70-100 times per day).

Stocking rate of fish varies from 4-15 kg/m^2, with individual size of stocked fish ranging from 50-150 g. Because this is an intensive culture system, the main source of nutrient for the fish is artificial pelleted feed given 3-6 times a day at a rate of 3-5% of body weight.

The culture period varies from 2-4 months depending on the initial weight and size preferred by the buyer, which can vary from 250-800 g. Survival is generally high at 95-99% with a feed conversion ratio (FCR) of 2.0-2.4:1. Annual production ranges from 40-90 kg/m^2.

The main problems encountered with this system are: lack of a stable supply of good quality seed in sufficient quantities, the rising cost of feed, declining water quality and competition from cage culture.

Common carp monoculture can also be carried out in earthen ponds utilizing the natural productivity of the pond as well as supplemental feeding. In intensive systems commercially prepared pelleted feeds are used exclusively and aeration is employed to increase the oxygen content of the water to enable higher stocking densities.

(b) Cage culture

Carps can also be cultured in cages placed in suitable water bodies, such as lakes, reservoirs and disused mining pools. Floating cages are used in deeper water bodies while fixed cages or pens are used in shallower waters. The cages are usually made of flexible polyethlene netting or some rigid material such as Netlon. In the case of floating cages, the net-cage is suspended from a platform (usually wooden) which is kept buoyant by floats made of styrofoam, fiberglass, plastic containers or steel drums. The cages are secured to prevent them from drifting as a result of winds.

The fish can either be cultured in monoculture (usually common carp) or polyculture. For polyculture a suitable selection of species is made, choosing fish with varied feeding and habitat preference. Care must be taken to ensure that the fingerlings are larger than the mesh size of the net-cage to prevent them from escaping. The fish make use of the natural productivity of the water body for feeding but supplementary feeding with cut grass, tapioca leaves, rice bran, or prepared feeds is also carried out. The excess feed also helps to fertilize the water body.

Harvesting of the fish is done by scooping the fish out of the cage when they reach marketable size. The bottom of irrigation and sewage canals. Fish, exclusively common carp, is stocked in these cages at a size of 8-10 fish/kg at an average density of 1 kg/m^2. The fish feed on the natural organisms present in the nutrient-rich sewage water. However, supplementary feeds may also be given. The fish are harvested at an average size of 0.8 kg/fish after six months.

(c) Free range culture

A common method of cyprinid culture is the release of fish in common water bodies such as lakes, reservoirs, dams and disused mining pools. The fish are allowed to range freely, foraging on the natural food organisms produced by the natural productivity of the water body. Some fertilization of the water body may be done to enhance the natural productivity. Supplementary feeding may also be carried out to some extent. Harvesting of the fish is usually done by means of netting.

(d) Polyculture in ponds

Polyculture systems for cyprinids are common all over Asia especially in China, Taiwan, Southeast Asia and the Indian subcontinent. The system relies on the different ecological requirements of the various species of fish in terms of feed and habitat (space). For instance, certain species may occupy different parts of the pond environment (*eg* surface, water column or bottom), while the species may also have different feed preferences or habits (*eg* herbivorous, omnivorous, detritivorous, phytoplankton feeder, zooplankton feeder, mollusc feeder, etc). In this way, an attempt is made to take optimum advantage of the pond ecosystem for aquaculture production.

In PR China the system involves some or all of the following species: grass carp, black carp, silver carp, bighead carp, wuchang fish *(Megalobrama amblycephala)*, common carp, goldfish, mud carp and tilapia. In Taiwan, a few other species are also used, such as the detritus feeding grey mullet *(Mugil cephalus)*, the algae eating milkfish *(Chanos chanos)*, the walking catfishes *(Clarias* sp*)*, the common eel *(Anguilla japonica)* and a number of piscivorous fishes (*eg* snakehead and Japanese sea bass) for controlling trash fish and excess tilapia fingerlings. In India polyculture systems can involve both indigenous species of carps (*eg* catla, rohu, mrigal and calbasu) as well as exotic species (*eg* silver carp, grass carp and common carp). Various other combinations of species are used in other countries.

Earthen ponds of 0.5-2.0 ha are commonly used for polyculture of carps. Water depth is maintained at 1.5-2.0 m. The pond is usually equipped with separate water inlet and outlet gates, usually located at diagonally opposing corners of the pond. Pond preparation usually involves drying, tilling and liming of the pond bottom. The ponds are then fertilized to promote primary and secondary productivity. Both chemical (inorganic) and organic fertilizers can be used. Chemical fertilizers used are phosphate, ammonium sulfate liquid ammonia and urea. Organic fertilizers include crop waste, compost, poultry dung and cattle dung. Human manure was also commonly used at one time.

The food for the fish consists of the phyto- and zooplankton and the aquatic weeds and animals (*eg* snails) naturally found in the ponds. Cut grass and tapioca leaves may also be given to feed the herbivorous fish. Sometimes processed feed mixtures or pellets are provided as supplementary feeds. Stocking rates and species combinations vary from place to place, depending on culture practices, environmental conditions and market practices. An example of stocking composition from Taiwan: grass carp (1,000/ha), bighead (400/ha), silver carp (150/ha), common carp (1,000/ha) and tilapia (30,000/ha). Since tilapia has a shorter culture period of 4 months, two stockings can be achieved within the same pond in a year, In India, a combination of five carp species may be stocked at overall densities of 15,000-25,000/ha with catla, rohu and mrigal as the major species and silver and grass carp as the other species.

Culture period ranges from about eight months to over a year depending on the species cultured and the desired marketable size. In the case of fish which need a shorter period to reach marketable size, such as the tilapia, more than one stocking and harvest can be achieved in a year. Average yields range from 5-10 mt/ha/yr. Higher yields can be attained with supplementary feeds and the use of aeration. The fish are harvested by draining the ponds and using nets to catch the fish.

(e) Integrated fish farming

The fact that polyculture of carps can utilize the organic fertilizer resulting from poultry, livestock and crop farming has led to the setting up integrated farms where one or more of these farming activities are carried out side by side with fish culture. The byproducts of the farming activities (especially manure) is used as fertilizer for the fish pond. Examples of such integration are duck-fish farming, chicken-fish farming, pig-fish farming, cattle-fish farming and rice-fish farming.

Usually the poultry or livestock are reared adjacent to or over the fish pond. In this way the feces of the animals can fall directly into the pond or can be washed into it. The pond (and fish) gain additionally from the excess poultry or livestock feed which falls into the pond and acts as fertilizer. When crops are grown in the integrated farm the cuttings or compost from the crops can also be used as feed or fertilizer for the fish. A special kind of crop-fish integration is that of rice-fish farming where fish such as common carp are stocked in flooded rice fields. The fish benefit from the natural food available in the rice fields while it is believed that the rice field may benefit from the fertilizing effect of the feces and other excretory products of the fish.

Integrated farming operations have the benefit that the waste or byproduct of one farming operation can be recycled in another. Integrated farming is thus seen to be environmentally friendly since it does not pollute the environment. However, there is the danger of transferring certain parasites or diseases from the livestock/poultry through the fish and other aquatic organisms to man if adequate precautions are not taken.