Reproduction and nursing of *Cirrhinus molitorella* in a small fish farm in Luang Prabang Province, Lao PDR

Tick NUANTHAVONG[1*] and La VILAYPHONE[2]

[1]Aquaculture of Indigenous Mekong Fish Species Component, MRC Fisheries Programme, [2]Ban Xepeing Village, Luang Prabang Disctrict, Luang Prabang Province

ABSTRACT

The propagation of *C. molitorella* has started in 1991 and this species is now considered domesticated. The Lao Sub-component of AIMS has supported several farmers in Luang Prabang in Northern Laos in producing *C. molitorella* through technical assistance and materials support. The present study describes the current technique for conditioning the fish breeders in ponds and for the reproduction, as practised in a small family fish farm in the Luang Prabang province. The study was carried out in 2005.

The broodstock of *C. molitorella* consisted in 35 fishes weighing 300-350. Fish were stocked in ponds (800 m^2) together with four other species of fish breeders. Fish breeders were fed with rice brand and local vegetables as main feeds and additional compound feed (30 % proteins) during the breeding season from May to August. The natural reproduction of *C. microlepis* was induced with a single injection of LHRH associated with domperidone. Spawning occurred six hours after the injection; the fecundity per female was about 31,000 eggs. Incubation of the floating eggs lasted 16-17 hours at 26-28°C; the hatching rate was 90 %. Trials of nursing were carried out successively in tanks (5-7 days) and in two kinds of hapas held in the pond for five weeks. The survival rate after nursing was about 20 %. Although this result could be improved, the net income from this activity was quite good, equivalent to 4-5 times the standard salary in rural area. Additional trials will be required in order to assess the performances of the reproduction of *C. molitorella* alone.

INTRODUCTION

The indigenous mud carp *Cirrhinus moritorella* is named 'Pa-ken' in the Lao language. Local people appreciate this fish because it is nutritive and also because old people can digest it easily. The rise of fishing pressure has lead to the reduction of the capture fisheries. Therefore, it is necessary to domesticate *C. molitorella* to meet the demand on the local market (Ounidate *et al.* 1993). Moreover, *C. moritorella* is an indigenous Mekong fish species that needs to be preserved. In terms of breeding in captivity, its reproduction is similar to *C. microlepis, Barbonymus gonionotus and Probarbus jullieni* (Somboon, 2001).

Artificial reproduction *C. molitorella* has been performed in the Luang Prabang Province (Northern Laos) since 1991 by the staff of the at Naluang Hatchery (State Farm) (Pinthip *et al.* 2001, Souksavath 2001). From 1991 to 1995, mature fish breeders were captured during the breeding period from several Mekong tributaries, including Nam Kong, Nam Karn and Nam Ou Rivers. Reproductionhas been achieved with fish breeders stocked in ponds at the Naluang station since 1996. This operation is supported by the LARReC in the frame of MRC-AIMS programme. At the present time, beside the Naluang station, *C. molitorella* is bred in two private farms including the

* National Agriculture and Forestry Research Institute, Living Aquatic Resources Research Center, PO Box 9108, Vientiane, Lao PDR
E Mail: larrec.aqua@laopdr.co

Mrs La farm which is presented in this study. Fingerlings of *C. moritorella* are distributed to three other local farmers in the surroundings for grow-out.

MRS. LA'S FISH FARM

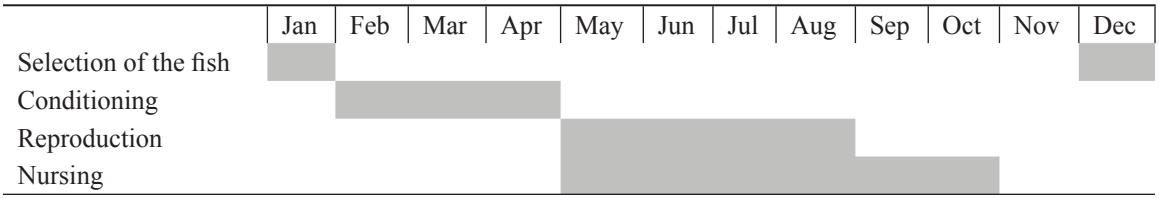
The livelihood of Mrs La and her family relies on fish farming. They live at Ban Xepeing Village, Luang Prabang District. They have collaborated with the AIMS activities since the year 2001. Their main source of income is selling fingerlings of *C. molitorella* and four other fish species, which brings in a total income of about 30,000,000 Kips per year. The detail return per species is not available. *C. moritorella* is a new species on the fingerlings market compared to other, and more common, species. Therefore, they can get better price from the fingerlings of *C. molitorella*. Technical assistance on the broodstock management and the reproduction techniques was provided to the family by the Naluang Hatchery.

The family owns only one fish pond (800 m^2) and four cement tanks for reproduction (200 L) and nursing (3 m^3) (Figure 1).

Figure 1. The single pond used for raising fish breeders and nursing the fish larvae (left) and Concrete tank used for the reproduction and nursing (right).

The labour for the maintenance of the pond and the fish reproduction is provided by the family alone. Beside *C. molitorella* (Pa-ken), the other species also bred at the Mrs La's farm include African catfish (*Clarias gariepinus*, Pa-duk), silver barb (*Barbodes gonionotus*, Pa-pak), common carp (*Cypimus carpio*, Pa-nay) and grass carp (*Ctenopharyngodon Idella*, Pa-kin-nha). All the propagation procedures of all the species are conducted on the farm, including conditioning of the fish breeders, reproduction and 45-50 days of nursing. The schedule of these activities is presented in the Table 1. It is also noteworthy, that beside the fish breeders, the nursing is also done in the same pond, either in hapas for *C. molitorella,* or in compartments in the pond for the other species. Lastly the ponds, to a limited extent, are used for grow-out of these species, plus Tilapia. The fish production is integrated with poultry or pig production.

Table 1. *Yearly schedule of activities at the fish farm.*



PROPAGATION AND NURSING

Broodstock management

In 2003, Mrs La purchased 40 one-year old fish breeders from the Naluang Hatchery (Luang Prabang Province). The average weight of the males and the females was 180 g and 200 g respectively. After raising the fish in the ponds for two years, the male fish (20 fishes) on average weighed 300 g and the females 350 g (15 females). These fish breeders came from the reproduction of other breeders stocked in ponds at the Naluang station for at least one generation, and possibly two or three successive generations. From 1991 to 1995, the fish breeders at the Naluang station were issued from the reproduction of wild and mature fish breeders captured in Mekong tributaries.

Fish breeders of *C. molitorella* were stocked in one pond (800 m^2) together with the four other species. The total biomass of fish breeders was about 161 kg (202 g per m^2), including 11 kg of *C. molitorella* (35 fishes x 320 g) and 150 kg of other species (214 fishes x 700 g). Therefore, *C. molitorella* was a minor species, only comprising about 14 % of the total amount of fish breeders. Feed was given twice a day and the composition and the feeding rate changed through the year (Table 2). Beside feed, fertiliser was applied with compost, dung, manure and mineral fertiliser.

Table 2: *Feeding practices for conditioning fish breeders.*

Period	Ingredients for the feed	Feeding rate (*)
Feb-Apr	Rice bran, Vegetables, Sweet potatoes, Soy been meal, cassava leaves	2-3%
May-Sep	Rice bran, Vegetables, Sweet potatoes, Tilapia feed, Catfish feed	5%
Oct-Jan	Rice bran, Vegetables, Sweet potatoes	2%

Note; Daily feeding rate expressed in percentage of the biomass.

The stock of fish breeders of *C. molitorella* at the Naluang station was different from that of Mrs La. She used about 280 fishes of between 3 to 4 years old and weighing 0.3-0.4 kg; the total biomass stocked in pond was about 100 kg. During the breeding season, fish were given commercial feed with high protein content (30-35%). Additionally, buffalo skin (2 kg) was put in the pond once or

twice a month as fertiliser to provide natural feed (i.e. plankton). Other feeds such as rice bran, termite, morning glory, cassava leaf and grass were also given.

Breeding of C. molitorella

Male and female of *C. molitorella* are similar; they can be distinguished only during the breeding season. The female has a soft and swollen belly with a large and pink genital papilla. The male has rough pelvic and pectoral fins, a thin belly, and sperm is produced while stripping. The mean body weight is 300 g for males and 350 g for females.

Semi-artificial reproduction is used for the breeding. Mature fishes are selected and put for 2-3 hours in a hapas hold in the pond. Then fishes are carefully transferred to circular concrete tanks (180-200 litres per tank), with two males and one female per tank. Water in the tank is aerated with a pump. Both hapas and tank are covered with net to prevent the fish jumping out. Spawning is induced by a single injection of LHRHa from Suprefact ™ (15-18 µg/kg) associated with domperidone from Motilium ™ (10 mg/kg). Half of the dose is applied to males. The injection is applied while transferring the fish from the hapas to the tanks at 6:00 since a cool temperature is suitable for breeding fish. Spawning occurs at 12:00 and hatching between 16:00 and 17:00 pm, the following day at the temperature of 26-28°C (Table 3). The fecundity of *C. molitorella* is about 31,000 eggs per female; the fecundity per kilo of body weight is 80-100,000 eggs.

Table 3: *Water temperature and pH measured in pond at the Naluang hatchery during the breeding period (mean value +/- SD).*

	Temperature (°C)	pH
Morning (7 AM)	26+/-0.4	7.3+/-1.2
Afternoon (2 PM)	28+/-0.2	8.5+/-0.6

Eggs are put in a small hapas made of plankton net held in the small concrete tank (180-200 litres); up to 100-150,000 eggs are put in the incubator. Water is aerated with a pump to provide oxygen and mixing of the eggs. After 16-17 hour incubation, the hatching rate is about 90 %; therefore about 28,000 larvae are obtained per spawning.

Nursing C. molitorella

Hatched larvae from two females (about 56,700 larvae) were kept in a 2.5 x 2 x 0.6 m concrete tank containing 3 m^3 of water. The stocking density was about 19 larvae/L and the nursing lasted 5-7 days. Water was aerated with a pump. About one third of the water volume was changed every day. During the first two days larvae use the yolk sac, and they start to feeding on the third day. Boiled egg yolk is given, once or twice a day with some additional green plankton harvested from pond. The quantity of feed should be adjusted so there is no over-feeding and no risk of

water pollution in the tank. After 5-7 days the survival rate is about 85 %; the amount of small fry harvested was 48,200 per batch.

Small fry aged 5-7 days were harvested and transferred from the tank to a first hapas held in pond. This hapas was made of plankton net with the size of 1.5 x 2 x 0.8 m containing 1.8 m^3 of water. About 5000 (about 2.8 larvae/L) of young fry were stocked in the hapas. Rice bran was given as feed together with plankton harvested from the pond. After 2 weeks 3000 fingerlings had been harvested 3000, therefore the survival rate was 60 %. The survival of small fingerlings aged 3 weeks from hatching was 51 %.

The small fingerlings aged three weeks were harvested from the first hapas and transferred to the second hapas to continuing the nursing. This hapas was made of standard 3 mm mesh net with dimensions of 3.5 x 3 x 1 m and containing 9.4 m^3 of water. About 5500 large fry were stocked in the hapas (approximately 0.7 larvae/L). Rice bran and floating pellets (25-30 %) were given as feed; fish fed also on the natural plankton from the pond. About 2000 fingerlings were harvested after 3 weeks, with a survival rate was 40 %. The survival of fingerlings aged 6 weeks from hatching was 20 %.

Mrs La conducted a test of the nursing protocol to three batches of larvae of *C. molitorella*. The results were similar for the three batches. The nursing protocol she applied to *C. molitorella* was similar to that used elsewhere for other carp species nursed in tanks and hapas.

Mrs La nursed the other species using a different protocol. After nursing 5-7 days in a tank, the young fry were released directly in the pond with compartments made of standard hapas net. The stocking density in the pond was 300-400 fry/m^2. Fry nursed in pond were fed with rice bran and commercial feed.

Budget of the production

After six weeks of nursing, the fingerlings of *C. molitorella* were sold for 100-150 kips per fish. This price is similar to that of the other species bred by Mrs La, except *Clarias gariepinus,* which sells for 200 kips per fish.

The budget presented in Table 4 was calculated for all the five fish species bred and nursed at the Mrs La's farm. It was not possible to get details for each species. The contribution from *C. molitorella* is probably minor, due to the relatively small number of fish breeders of this species (14 % of the total).

Labour is provided from within the family and no additional workers are used. The total labour spent on the farm each year is around 172 people-days, shared between 91 people. The daily maintenance takes one person two hours per day and 81 people-days are required to help with fish breeding activities (3 people during 27 days per year). The labour costs are is 115,000 kips/person.

day. This is well paid work, being 4-5 times higher than the normal salary in rural areas (25,000 kips/day).

Table 4: *The budget for Mrs La's fish farm*

1. Fixed costs

Item	Total cost (Kips)	Duration of use (years)	Cost per year (Kip)
Hatchery	10,000,000	5	2,000,000
Tools	3,000,000	2	1,500,000
Digging ponds	10,359,152	20	517,958
Maintenance of ponds	1,361,667	4	340,417
Hapa nets	1,000,000	3	333,333
Total			4,691,708

2. Operational costs

Items	Total/year (kips)
Feed	2,500,000
Electricity	1,000,000
Hormones	1,500,000
Miscellanous	500,000
Total	5,500,000

3. Total costs (Kip): 10,191,708

4. Income from selling fingerlings

Value / fingerling (Kips)	No. fingerlings	Total value (Kips)
150	200,000	30,000,000

5. Net income (4 - 3) (Kips): 19,808,292

CONCLUSIONS

Although only a single pond was available, the profit obtained by Mrs La from breeding and nursing *C. molitorella* and the four other species was quite high. The farm is now self-sufficient in fish breeders and regularly renewed with its own fishes. The farm is also relatively autonomous in terms of fish feed since most of the ingredients are produced at the farm or purchased locally; only a little quantity of commercial feed is used. Moreover, the market for *C. molitorella* is growing. Therefore, Mrs La's farm can be considered as a sustainable model to improve livelihoods in the montainous areas. At the time of the study, Mrs La was willing to extend her activities to grow-out of *C. molitorella*.

The standard conditions used for the broodstock management and the reproduction were good, as indicated by the high fish fecundity and hatching rate. However, the survival rate after nursing was low, especially during nursing in hapas. It is noteworthy that such poor result often occurs with species of carp in similar conditions in Lao PDR. Improvement of the nursing will require more trials with fry stocked in hapas or released into ponds. Otherwise, we recommend more accurate assessment of the performance of reproduction of *C. molitorella* since the fish breeders were mixed with four other species in the present study. Finally, it would be interesting to gather information related to the reproduction and the nursing of *C. molitorella,* for different generations of fish issued from controlled reproduction and raised in ponds. In this way we could assess the effects of the domestication.

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