

Malaysian school engages in bullfrog and turtle farming

By NJ Dagoon

“Sepang Today Aquaculture Centre is a private aquafarming training school in Malaysia,” says owner and president Mr. Khoo Eng Wah.

The school offers courses on the culture of two exotic animal species: the American bullfrog and the soft-shelled turtle.

What follows is a brief description of the culture method for each, taken from the school’s training brochures.

American bullfrog

The American bullfrog is the second largest and heaviest of frogs. It may reach a



Brooder frog size is about 300-350 g. In the male adult bullfrog, the diameter of the eardrum membrane is bigger than that of the

length of 30 cm and weight of 1.5 kg. Originating from North America, it is known by its peculiar booming call, which can be heard half a mile away. Among edible frog species, it is the dominant one for human consumption.

Commercial culture of the American bullfrog *Rana catesbeiana* in Malaysia is thought to have begun in the early 1980s. With the use of Taiwanese techniques on feeding, stocking and disease prevention, bullfrog farming has become a profitable industry.

Seed production

Sex differentiation among adult bullfrogs is easy. Small size, brown skin with black stripes and a black or white throat distinguish females. Large size, light green skin and yellow-colored throat characterize males.

Mature adults are separately raised by sex at a density of 3-4 frogs per m² in 4 x 10 m pens filled with constantly flowing

water at a 10 cm depth. Live food such as fish, tadpoles, crickets, and earthworms are given.

Breeding pens with 10-cm deep flowing water and modified bottom (to enable about 25% to be kept dry when in operation) are used to spawn broodstock at a ratio of 1 male to 2 females. These makeshift ponds are typically shaded by water hyacinth (*Eichhornia crassipes*).

With no feeding at all, spawning occurs after 3-4 days in the early morning hours. A female can lay about 10,000 eggs in a jelly-like mass or more 8-10 times a year.

Eggs are transferred to 2 x 1 m hatching tanks. The 10 cm water depth and shade are maintained. Each hatching pool is provided with a continuous fine spray of water for aeration and current flow. The water temperature range is maintained at 27-29°C. Larvae hatch within 36-48 hours. Within 24 hours, feeding is begun, and tadpoles are transferred to nursery ponds.

A 1-m water depth is maintained in earthen tadpole ponds (size, 4 x 4 m). As in hatching tanks, a continuous fine spray of water and shading is provided. Aeration is needed when dissolved oxygen is low. Hatchlings are stocked at a rate of 300-400 tadpoles per m². Food such as spinach, cereals, brine shrimp, fish meal, liver, wheat bran-minced fish mixture should be available at all times. During the first 3 weeks and before late metamorphosis (appearance of front legs), daily food consumption is about 20% and 7% body weight, respectively. Young frogs are collected as they emerge to seek cover.

Grow-out

Size range of grow out ponds is 10-100 m². The pond is partly shaded; at least half is exposed. Regular running water is maintained at a 2-10 cm depth, depending on frog size. A fine mesh (1-3 mm) fence with minimum height of 1.5 m encloses the pond. Ponds are stocked at a rate of 50 frogs/m² after metamorphosis.

Water that is clean, recirculated, tepid, and oxygenated is vital. Strict hygiene and sanitary control is maintained during all



Trainees at the school's bullfrog farming pond

About the School

Selang Today Aquaculture Centre started in 1996. The school is located about 30 km from the Kuala Lumpur International Airport. It is owned and managed by Mr. Khoo Eng Wah who has a biology degree from Nanyang University of Singapore and a postgraduate diploma in fisheries from the University of Singapore. He once attended the 1st *International Conference on the Culture of Penaeid Prawns and Shrimps* in Iloilo, Philippines in 1983. Mr. Khoo's work experience includes having been a biology and agriculture teacher for a private high school and manager of various fish farming projects (freshwater prawn, fishes, ducks, etc.). Since 1996-97, he has been operating a tiger prawn hatchery and grow-out farm, operating a school for training aquafarmers and investors and investing in turtle and bullfrog farming.

For the past 3-4 years of its existence, the school has trained hundreds of aquaculture farmers and investors from different parts of the world. Some of these, he mentioned come from Saudi Arabia, Seychelles, Brunei, Colombia,

China, Taiwan, Indonesia, and Malaysia.

Though Mr. Khoo himself serves as the main lecturer at his school, he has invited a lot of part-time lecturers from Malaysian universities and other private aquafarm operators to give lectures and share their experiences with the course participants.

The school's farming pond facilities include ten units of 2,000 m² pond for tiger prawn/banana prawn, one unit 2,000 m² pond for seabass, one unit 1,000 m² pond for sea red tilapia, one 100 m² tank for mud crab, and one 50m² tank for swimming

crab. There are also hatcheries for breeding of seabass, and tiger prawn/banana prawn/freshwater prawn (each can produce about 1.5 million fry per run). The school has a well equipped laboratory for the performance of different tests.

Course offerings for year 2000, Mr. Khoo reveals, are Tiger prawn/*Penaeus indicus* hatchery and grow-out farming (30 days), Freshwater prawn (*Macrobrachium rosenbergii*) hatchery and grow-out (30 days) and Seabass (*Lates calcarifer*) hatchery and grow-out (30 days). Each course is US\$1,950 inclusive of food (3 meals per day, refreshments), lecture notes, practical work in hatchery and grow-out, tutorials, farm visits, etc.

Home study is also available for different species of aquatic products at US\$200 per course.

The school also offers 10-day intensive grow-out farming courses on tiger prawn/*Penaeus indicus*, seabass, freshwater prawn at US\$1,000 per course inclusive of food and lodging, tuition, materials, farm visits, practical work, etc. The school can be contacted at the website: www.Todayaqua.com.

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stages of culture. Care must be taken to prevent contamination by pathogenic organisms. Culture tanks should be washed daily.

To reduce cannibalism (which may occur at the rate of 10-30% during the first 60 days), frogs are graded by size. Frogs are fed about 3-5% of their body weight per day. Bullfrogs have a good feed conversion ratio (1:1). In about 4 months, a bullfrog can reach the slaughter weight of 250-300 g. The animals are hand-collected, placed in sacks, and transported to the processing area.

Marketing and processing

Mr. Khoo explains the cost of bullfrog production. Frog farm construction is very cheap, he notes, requiring a capital of about RM 100,000 (note US\$1 = RM 3.8). With that investment, a farm can produce about 15 tons a year. Ex-farm price per ton is RM??. Annual sale realized is RM 150,000. Profit is RM 45,000 (maximum range, RM 100,000-150,000).

In Malaysia, cost of bullfrog production is RM 6-8 per kg.

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“Ex-farm price for live frog is RM 9-13. It is a profitable venture,” says Mr. Khoo.

Currently, the domestic market absorbs most of Malaysia’s annual frog meat production. Domestic prices are higher than those offered by exporters. While exporters want just legs, local restaurants buy the whole carcass.

Bullfrog meat has fine texture and pleasant taste. Low in fat (0.5%), it is rich in protein and provides a good balance of amino acids. These characteristics appeal to health-conscious consumers.

Dressed bullfrog (beheaded, skinned, gutted, and digital extremities cut off) weighs 70% of its live weight. Legs account for 60% of dressed carcass weight.

Processing of frogs is similar to that of poultry. The final product is packed in polythene bags, individually quick-frozen and stored in a cold room at -23°C .

Various useful by-products can be obtained from frog processing. Tanned frog skin yields leather. Fat reserves in the frog’s abdominal cavity are processed into cosmetic oil. Dried and ground offal from frog processing may be used in the manufacture of frog feed.

Future potential

Bullfrog meat has a great potential in the local and international market, since it is a popular traditional gourmet food among Asian and European communities.

Frog culture also helps frog conservation as it minimizes uncontrolled collection of frogs from the wild. Frogs bred in captivity can be used to replenish depleted populations.

Soft-shelled turtle

People in China and Japan traditionally favor the soft-shelled turtle (*Trionyx sinensis* Weigmann) as a highly esteemed delicacy with nutritional and medicinal values.

There are only two well-established hatcheries and a few small scale grow-out farms operating in Peninsular Malaysia. These farms are located at Rawang, Mantin, Gemetar, Pagoh and Kota Tinggi.

Seed production

Soft-shelled turtle males and females take one year to reach maturity. One male or female adult is about 1 kg. One female can lay 10-20 eggs per batch and about 60-80 eggs per year. The eggs hatch out into baby turtles and each seedling weighs about 5 g. Farmers buy the seedling at this stage at about US\$1 per piece.

According to Mr. Khoo, the price per seedling has fallen to about US\$0.1 since 1999, because China is currently imposing a ban on the import of seedlings from ASEAN countries. The market price fell from US\$10 per kg to US\$4 per kg. Before the ban of imports to China, there were about 200 farmers in Malaysia, with most growing 50,000-500,000 seedlings.



PHOTO COURTESY OF KHOO ENG WAH

Breeding pond for turtles, note egg laying site on foreground

While maintaining their grow-out ponds, two Malaysian commercial hatcheries produce soft-shelled turtle seed for the industry. Broodstock are kept in ponds with vertical concrete embankments and sandy bottoms. These prevent turtles from escaping, and provide substrates that reduce chances of cannibalism and enhance growth of hatchlings. Floating wooden planks, besides being basking areas for turtles, also prevent algal or fungal growth. Size of turtles determines water level and substrate depth.

Spawners are selected from fast-growing and good quality 2- to 3-year-old adults. They are stocked at a sex-ratio of 1:3-4 (male: female). In tropical countries, eggs are laid all-year-round with a short inter-nesting period. Spawning normally takes place at night. Female selects a nesting site; digs a 15-20 cm diameter hole with a depth of 8-12 cm; and then lays eggs in it before covering it up. Number of eggs per clutch is about 10-15, depending on spawner size.

Spawning and grower pond area varies at 200-1000 m². Each spawning pond has an egg-laying site, a 1.5-2.5 m² rectangular platform that contains 15-25 cm deep sand. Each site has wooden walkways extending into the water. The roof is made of galvanized iron sheets raised 1-1.2 m above floor level.

Egg-laying sites are checked every morning for signs of nesting. If there are signs, the eggs are dug out. When transferring to plastic containers, eggs must be handled with care. Eggs are kept in wooden boxes for 1-2 days before fertilized eggs (those with small “white caps”) are selected.

Fertilized eggs are then transferred to sand beds in the hatchery for incubation. Eggs are arranged in rows with the “white cap” facing upward, spaced at a distance of 1-2 cm apart, and buried under a 5 cm layer of sand.



Turtle eggs



Just hatched baby turtles



*Turtle adults
readied for
the market*

Fencing the incubation site guard against predators and pests such as ants, rats and snakes. This site must be sheltered from direct sunlight and rain.

Humidity of sand beds must be closely monitored, as sand beds that are too wet or dry damage fertilized eggs. Under normal conditions (25-30°C), hatching takes place in 45-60 days. A small basin of water is placed at the corner of the incubation bed. Newly hatched turtles will come out from the sand and crawl to the basin.

Newly hatched turtles are removed daily from the basin in the incubation site and transferred to the nursery tank. One hatchery setup uses concrete tanks with fine sand substrate and good water quality; the other nurses hatchlings in covered netcages suspended in a small river or pond. Depth of water is adjusted according to the level desired.

Hatchlings are fed with high quality food such as commercial feed, bloodworm, fresh trash fish or poor grade chicks. Growth rate of hatchlings is dependent on quality of feed, stocking density and water quality. To reduce cannibalism and improve the growth rate of smaller hatchlings, segregation must be carried out when size differences become apparent. Hatchlings are nursed up to about 10-12 cm in carapace length before being transferred into grow-out ponds.

Grow-out

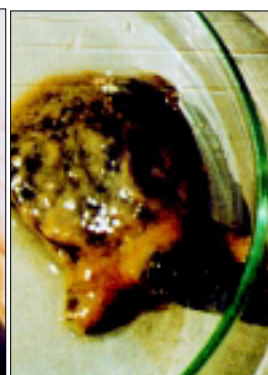
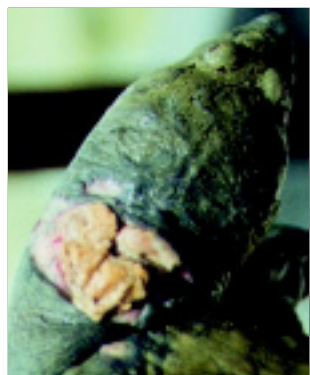
Grow-out ponds, vertical concrete embankments with sandy bottoms, vary from 200 to 1000 m². Depth of water range is 50-70 cm with freeboard allowance of 30 cm to prevent turtles from escaping.

Pond preparation is an important aspect of management. Before stocking, ponds are prepared by drying the bottom. Lime is added to disinfect and improve the soil condition. Algae and aquatic weeds are removed because they may prevent turtles from coming up to breathe. Pond bottoms are cleaned to prevent anaerobiosis.

Water quality is determined by observing color of water as well as activity and behavior of turtles. Phytoplankton blooms are controlled at about 15-30 cm secchi disk visibility. Water quality is maintained by water exchange. Water parameters to be

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From left to right: turtle with head ulcer disease, shell ulcer disease, deformed shell; and a baby turtle covered by the protozoa Zoothamnium



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observed are a pH of 6.5-8, alkalinity of 30-40 ppm, salinity of 5 ppt (more than that level, mortality will occur), and iron content of not more than 0.2 ppm. Dissolved oxygen should not be less than 3 ppm.

Turtles are stocked at a density of 8-12 per m². Being a carnivorous species, *Trionyx sinensis* requires high protein (45-55%) and low fat diet. They are fed with trash fish, poor grade chicks, and intestines of poultry. Feeding is done once or twice daily, in the morning and/or afternoon at about 2% body weight.

To reach the size that can be sold in the Chinese market (400-600 g), farming period is about 6-8 months. Sex segregation is generally undertaken when the turtles mature, as females become subject to male biting attacks.

Marketable sized turtles may be harvested partially or completely. Partial harvest is done by lowering the water level and capturing the animals by hand. Complete harvest involves draining the water. Turtles of insufficient size are transferred to grow-out ponds for further culture. The marketable turtles are placed in tanks with running water to clean them before delivery to customers. Fast-growing turtles may be chosen as broodstock.

Markets

To prevent fighting, turtles bound for market are segregated individually in small nets or black perforated plastic bags. Adult turtles are normally sold live to export and local markets. Poor grade hatchlings can be also sold to aquarium shops as pets. Unfertilized eggs can be processed into medicinal food.

Outside Malaysia, the major market for turtles are China, Japan, Taiwan, Hongkong and Singapore. Local demand for cultured turtles has increased recently due to lack of supply from the wild.

Future potential

The potential of rearing soft-shelled turtles in tropical environments seems bright. Higher ambient temperatures for poikilotherms like reptiles and fish stimulate rapid and consistent growth patterns.

Taste for the soft-shelled turtle has to be acquired. Currently, only those with exotic, epicurean taste appreciate it. (Muslims do not eat it.) There is a need, therefore, to develop the delicacy's mass appeal, as well as explore and prove its medicinal value. Gory displays of public slaughter should be stopped to avoid casting a negative light on the development of turtle-derived products.

Conclusion

Cultural prejudices against exotic aquaculture species must be overcome to ensure the continuous development of their industries and markets.

This article is based on extension materials from the Sepang Today Aquaculture Centre and from responses to a questionnaire emailed by Mr. Khoo Eng Wah to NJ Dagoon

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and Taiwan (over 20,000 tons) and 2,500 tons from elsewhere.

According to Mr. Torres, the biggest challenge to European growers is the high price of growing glass eel. There is huge demand for European elvers from China. He said the bigger problem is sustainability -- there may be no glass eels left in four or five years. EU should either stop or regulate this trade. *Fish Farming International* estimated that 65-75% of Europe's glass eels are being exported to the Far East.

The European Eel Fisheries Conservation Group (EEFCGO) has already issued a strong warning last year that too many eels from European waters are being exported across the world. Most die before they reach maturity and their steady depletion threatens eel fishing in Europe, as well as the further development of eel cultivation (*Fish Farming International*, February 1999). There are also reports that the International Council for Exploration of the Seas (ICES) has concluded that adult spawning stock of European eel (*A. anguilla*) is now outside safe biological limits. Between 1996 and 1997, France exported 150 tons; Spain, 70 tons; and UK, 30 tons at prices reaching up to US\$327 per kg of elvers.

Aquaculture potential

The factors that favor eel culture include the following (Usui 1991):

- Biological: high survival rates in culture, high tolerance to water quality variables (salinity, oxygen, nitrogenous waste), highly adaptable to a variety of diets (natural and artificial), high satisfactory growth rates (commercial size of 150-250 g can be reached in 12-24 months at optimum temperatures of 22-24°C).
- Technology: highly established rearing methods
- Economics: high value as food, high sale price, high commercial demand which exceeds supply (deficit in Europe is estimated at 13,5000 tons a year), elvers and young eels are available in the wild (estuaries and lagoons), and there are some opportunities to combine fishing and rearing
- Scientific: there is active research and extensive literature (Brusle 1990). The principles of eel culture are the same as for all fish culture

Eel culture in the Philippines

Eel culture is still in its fledgling stage. Known as *igat*, *casili* or *palos*, it started in the early '70s when the estuarine delta of the Cagayan river in northern Luzon has been discovered to yield commercial quantity of elvers. The elver season in the Philippines occurs most of the year but it peaks in March and August.