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Some technical and management aspects of catfish hatcheries in Hong Ngu district, Dong Thap province, Vietnam

H. P. Hung[1,2], N. T. T. An[1], N. V. Trieu[1], D. T. Yen[1], U. Na-Nakorn[2], Thuy T. T. Nguyen[3]

1. College of Aquaculture and Fisheries, Can Tho University, Vietnam; 2 . Faculty of Fisheries, Kasetsart University, Ladyao, Jatujak, Bangkok, Thailand; 3. Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand.

Dong Thap Province in the Mekong River Delta (in Vietnamese it means Delta of Nine Dragons) has a tropical climate and an abundant supply of fresh water the whole year-round. It borders Cambodia to the North, Vinh Long Province to the South, Long An and Tien Giang Provinces to the East; and Can Tho and An Giang to the West.

Dong Thap is also known as one of the provinces where the tra catfish, *Pangasianodon hypophthalmus*, aquaculture industry is well established. In 2006, the province produced 300,000 tonnes of catfish, contributing 37.5 % to the total production of Vietnam catfish aquaculture production. Catfish aquaculture in the province also employs about 40,000 people, out of the 1.6 million people who are living there.

Since the breakthrough in artificial propagation of catfish species in 1996, many farmers in Hong Ngu district of Dong Thap have changed from traditional rice cultivation to catfish breeding and culture. This change has significantly improved the income of farmers over the years. Statistics for 2007 show that the province has 87 catfish hatcheries, producing more than 4.4 billion larvae per year. Together with its neighbouring province of An Giang, Dong Thap is considered an epicenter of catfish seed supply for the whole Delta. In this article, we report some technical and economical aspects of 30 hatcheries in Hong Ngu district of Dong Thap province, based on a survey undertaken between July to September 2006.

General characteristics of hatcheries

All surveyed hatcheries were built after 1999. It is usual that owners also act as the chief technicians, and their level of education varied, with 80% having high-school certificate or higher, and with an age range of 31 to 60 years old. The majority of chief technicians (73.3%) gained their expertise through training courses, while 13.3% gained their experience through university degree, and the rest (13.3%) learnt from other hatcheries. There are often three to six persons working in a hatchery, who tend to be mostly family members and one to two persons from outside, usually neighbours.

Hatchery areas ranged from 0.2 to 3.0 ha, about 40% of which is used as broodstock ponds. Hatcheries maintain on average about 1,700 brood fish (about 4 kg each) with capacity to produce about 200 million fry per year. However, not all broodstock are used every year. For example, only 26% of broodstock was used to spawn in 2005. Hatcheries kept about 4% of fry and rear to fingerling, and the rest was sold to secondary hatcheries or nurseries for fingerling rearing and subsequently sold to grow-out farmers. The price of fry and fingerlings have significantly declined over the years, from about 52 VND and 532 VND, respectively in 2001, to 1 VND and 106 VND in 2005 (1US$ = 15,800 VND in 2005). Relevant information on hatchery production is given in Table 1.

Broodstock management, breeding and seed quality

The origin of broodstock varies between hatcheries. About 43% of hatcheries obtained wild-caught broodstock, 30% have only broodstock from hatchery origin, and the rest have a combination of both hatchery-produced and wild-caught

Table 1. Average number of brooders, fry, and fingerlings produced in the 30 hatcheries surveyed from 2001 to 2005. Number in parentheses indicate the range.

	2001	2002	2003	2004	2005
Number of broodstock	202 (50 – 1,000)	248 (50 – 1,000)	374 (75 – 1,850)	382 (88 – 1,000)	456 (100 –1,125)
Number of fry/ year (million)	118.2 (6.0 - 300.0)	120.4 (6.0 - 300.0)	123.9 (5.0 - 300.0)	196.9 (5.0 - 500.0)	155.6 (6.0 - 800.0)
Number of fingerlings (million)	50.3 (0.1 - 500.0)	50.4 (0.1 - 500.0)	19.2 (0.2 - 200.0)	23.2 (0.2 - 300.0)	12.1 (0.2 - 150.0)

broodstock. Most broodstock (59.7%) are 5 to 7 years old, 38.3% are under 5 years old, and a very small proportion is older than 7 years.

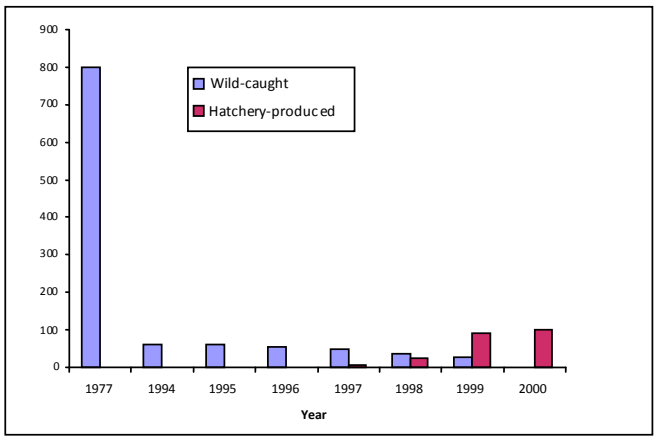
Broodstock can be from one generation or many. The number of hatcheries that had broodstock from one, two, three and four generations were 37%, 20%, 20% and 23%, respectively. It is interesting that 62% of hatcheries reported that broodstock procured from the second and third generations usually spawn at a younger age compared to those from the first generation.

Broodstock ponds were repaired and cleaned every 1 – 1.5 years. During the pond maintenance period, water and sediments were drained out. Powdered lime was then applied at an average of 6 kg 100 m^{-2}. Brooders were stocked at an average density of four fish per 10m^{-2} with a sex ratio of one male to four females. Broodstock were fed with commercial pellet feed at an average of 6.20 kg of feed for 100 kg of fish per day.

Each brooder spawned twice to four times a year. In 80% of hatcheries, fish that had spawned were marked by writing on the head, and 13.3% hatcheries kept fish that had spawned in a separate pond. Average age at the first spawn was 3-4 years old, equivalent to 3-4 kg fish. The best spawners (in terms of fecundity, hatch rate and survival rate) were aged 4 – 5 years (4-5 kg fish). Fish that were older than 7 years (7-8 kg) were often removed from the broodstock.

The breeding season for catfish in Vietnam is from February to September, with a peak from March to July. Variation in spawning rate, hatching rate and other parameters are highlighted in Table 2.

Figure 2. Wild-caught and hatchery-produced seed production in Vietnam (Tung et al., 2001)



Broodstock were conditioned prior to the spawning season, normally from November to January, when they were fed with a special diet which contains more than 30% protein. Levels of maturity of females were checked by observing the oocytes using a catheter. As for males, milt was checked by stripping. The ratio of males to females for each spawning was usually one to four.

Females are injected with HCG (sometimes using LH as an alternative) five times including one preliminary dose of 1,000 IU/kg, two to three derivative doses of 500 IU/kg and one determination dose of 3,000-4,000 IU/kg. Sperm and eggs are mixed and then incubated in a system of conical jars (WEIS) at an average of 120,000 – 150,000 eggs in a 20 liter jar. Hatching time ranges from 3-5 days.

About 73% hatchery owners thought that seed produced from hatcheries are of equivalent quality to those collected from the wild, but suggested that seed from the F1 generation (i.e. their parents are collected from the wild) is probably of best quality. In contrast, other 27% believed that quality of seed collected from the wild are better than those produced from hatcheries. Inbreeding or genetic relationships amongst brooders are not taken into account in the management of broodstock in more than half (56.7%) of the hatcheries surveyed.

The price of larvae and fingerlings varied according to seasons. During the main spawning season, the price was often much lower (0.8-1.2 VND/larvae) compared to that during the early and late seasons (7-8 and 3-4 VND/larvae, respectively). Hatcheries claimed that they could not make profit during peak spawning season, and therefore they only spawned fish during early and late seasons, and only a small number of brooders were used in the main season.

Discussion

Catfish aquaculture in Vietnam has a history dating back to 1960s when fish were mainly grown in latrine ponds, and the produce were mainly for domestic consumption. Traditionally, the industry depended largely on wild-caught seed, mainly from Cambodian Mekong of Kampong Cham, Prey Veng and Kandal provinces and to some extent in Dong Thap and An Giang provinces of Vietnam. However, the Cambodian government banned the tra catfish seed collection in 1994 (Figure 2) and the break-through in catfish artificial propagation came about two years later. The industry since then has grown dramatically and has become of the fastest growing primary industries in the world.

Table 2. Performance of broodstock in different breeding seasons.

	February - March	March - July	July - September
Average success spawning rate (%)	59.3	91.4	57.7
Fecundity (1,000 eggs/fish)	49.7 ± 20.7	127.2 ± 43.7	59.7 ± 29.4
Fertilisation rate (%)	78.7 ± 15.1	93.6 ± 6.8	81.0± 14.4
Hatch rate (%)	75.6 ± 10.8	92.2 ± 7.6	72.0 ± 13.0

The success in hatchery production of tra catfish brought to the front problematic questions relating to impacts of breeding and management practices upon genetic diversity of cultured stocks, which is expected to be maintained for long-term sustainability of the sector. These problems are more pronounced with the fact that introduction of new genetic materials is almost impossible due to the ban of collecting wild seed imposed by Vietnam government in 2001. There have been documented cases in many fish species of genetic changes and loss of genetic variability in hatchery-reared stocks, and also resulting in alteration of genetic diversity of their wild counterparts due to interbreeding with escapees of hatchery-reared stocks (Crozier, 1993; Clifford et al., 1998) or those used for restocking (Bentsen, 1991; Hindar et al., 1991;). In this regard, the present preliminary survey has highlighted important implications in hatchery management of tra catfish farming in Vietnam.

This discussion will mainly focus on factors that could contribute to the reduction of effective breeding number (i.e. the number of broodstock that contribute their genetic materials to the next generation, one of the most important information on genetic status of the broodstock). It was observed that the number of broodstock maintained in each of the surveyed hatcheries is relatively high, ranging from 100 to 1,125. However, there was no information regarding the number of broodstock which were used for spawning and there is a possibility that not all fish are used to produce larvae. Furthermore, spawning rate in early and late season are relatively low (57.7-59.3%), which could further reduce the effective breeding number. This coupled with low fecundity, fertilisation rate and hatching rate (Table 2) exacerbate problems of inbreeding, and increased variance in family size (different number of survived offspring to be recruited as new broodstock).

Often hatcheries use milt from one male to fertilise eggs of several females, and in this instance the ratio is one to four. This highly skewed sex ratio would reduce the effective breeding number substantially, compared to the “ideal” sex ratio of one to one (Tave, 1999). Furthermore, the artificial fertilisation using pooled milt and/or eggs may result in increased variance of family size due to differences in ability to fertilise. This will eventually lead to reduction of effective breeding number (Wither,1988) of sperm/ eggs from different individual broodstock. In some hatcheries, individual broodstock were repeatedly used within a year (up to four times a year), and this will also further contribute to the reduction of the effective breeding number.

Economic factors, such as the fluctuation of price of larvae between seasons is also a factor to be considered. Often the price of larvae during the main breeding season is much lower than that during early or late season. This would encourage hatcheries to produce more larvae during off-peak seasons when broodstock performance is poor in terms of spawning rate, fertilisation and hatch rate.

In general, all issues discussed above highlight a common problem – reduced effective breeding number, and as a consequence, high levels of inbreeding (the mating between closely related individuals), as well as genetic drift (random changes in allele frequency). Inbreeding often causes a decrease in productivity (i.e. inbreeding depression), and genetic drift can alter gene frequency and eliminate alleles, which can decrease a population’s ability to survive or to adapt to an altered environment. The goal of management is to reduce inbreeding and genetic drift.

The issues highlighted in this paper are probably a result of lack of training for hatchery managers/ owners in genetic management of broodstock. It is crucial that a programme should be designed to target this technical level for better hatchery management. In addition, better management practices should be developed, based on more extensive surveys, and awareness on broodstock management should be introduced sooner rather than later in order to ensure good seed supply, contributing to sustainability of the sector.

The above suggestion does not imply training of hatchery managers in advanced genetic techniques but basic know-how on how to maintain and use available broodstock to the best advantage. This basic knowledge will be easily taken up by entrepreneurial Vietnamese hatchery operators, who are always willing to introduce improvements.

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