



Mekong River Commission

**Status of Pangasiid aquaculture
in Viet Nam**

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Editor: Ann Bishop

© **Mekong River Commission**
P.O. Box 1112, 364 M.V. Preah Monivong Boulevard
Phnom Penh, Cambodia
Telephone: (855-23) 720-979 Fax: (855-23) 720-972
E-mail: mrcs@mrcmekong.org
Website: www.mrcmekong.org

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Background of the Working Group on Mekong Giant Fish Species

The Technical Advisory Body on Fisheries Management (TAB) of the Mekong River Commission (MRC) was established in June 2000. The TAB gives advice to the MRC Fisheries Programme on technical issues relating to basin-wide fisheries management. During the first meeting, five main issues were identified. Among these was the following:

Management of *Pangasius* (River catfish)

The Meeting considered under this item in particular, Pangasianodon hypophthalmus. The size of fish caught has been declining, pointing to overexploitation. A fry fishery for aquaculture purposes, while illegal in some countries, may still be taking place. Fry of other species are also being caught as unwanted by-catch. The TAB is concerned about this situation.

It was agreed that the MRC Fisheries Programme (Cambodian Capture Fisheries Component, Assessment of Mekong Fisheries Component and Aquaculture Extension Component) shall produce two "status reports" on Pangasianodon hypophthalmus, summarising what is presently known on spawning and feeding habits, migrations of fry and adult fish, fishing efforts and possible management interventions, as well as the use of the species for aquaculture, the status of artificial breeding, and an assessment of whether increased availability of artificially-produced fry might eliminate the collection of wild fry. The report will be submitted to the TAB.

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Summary

Wild caught river catfish (*Pangasianodon hypophthalmus*) from the Mekong River have been an extremely popular food fish in Viet Nam for centuries. This report details the developments that have produced impressive increases in cultured production of river catfish over the last two decades.

Information is provided on the wild seed fishery, technical developments in breeding and nursing of river catfish and culture methods, including pond and cage culture systems, illustrated with photographic examples. Cultured river catfish production data by culture systems are also listed for provinces in the Mekong River delta area of Viet Nam.

Culture of river catfish, first reliant upon wild seed caught seasonally each year, has also been conducted for centuries. As pond and cage culture operations expanded in Viet Nam and also Cambodia, wild stocks of river catfish seed were decimated through over-fishing and destructive fishing methods.

In the early 1980s hatchery operators in Viet Nam first mastered spawning and later in the 1990s nursing of river catfish. As a result cultured production of river catfish soared, reaching an estimated 20,000 metric tonnes by 1999.

This report synthesises in a single readable volume, important information only previously available in Vietnamese and French reports and scientific papers. The historical information and the present status of river catfish culture in Viet Nam are of national and regional significance to both technical staff and policy decision makers within the aquatic resources sector. In addition this report gives specific examples of the interaction between wild capture fisheries and aquaculture, neither of which can be considered in isolation.

1. Background

River catfish have been cultured for centuries in ponds in the Mekong delta of Viet Nam (Peignen 1993, cited by Cacot 1999), and today are an important culture species. Annual production is estimated at 20,000 tonnes, which is sufficient to meet the demand of domestic markets (Cacot 1999).

P. hypophthalmus have air-breathing organs and are obligate air breathers (Browman and Kramer 1985; cited by Cacot 1999). This enables river catfish to tolerate poor water quality, including high organic matter or low dissolved oxygen levels, and they can therefore be stocked at high densities. River catfish are omnivorous. When cultured in ponds and cages, they will accept trash fish, pellets, home-made feed formulated from agro- and fishery by-products, water plants and even animal and human wastes. In Viet Nam, river catfish are commonly stocked in ponds with latrines over hanging them.

2. Status of wild river catfish larvae

A series of studies have failed to find any river catfish spawning grounds in Viet Nam (Ministry of Fisheries, cited by Khanh 1996). Early in the monsoon season, wild adult river catfish migrate out of the Great Lake and go down the Tonle Sap river, before swimming up the Mekong river to spawn below the Khone Falls on the Lao-Cambodian border (See Map, Appendix I). There, environmental conditions are suitable for gonad development and breeding (MRC 1992).

Traditionally, river catfish culture systems in Viet Nam relied entirely on wild caught fry, with 200-800 million fry being caught annually (Department of Freshwater Fisheries 1977; Department of Agriculture of An Giang province 1977; cited by Khanh 1996). Following spawning, fixed bag nets, typically 10-15 m long, with mouths 5 m wide (see Appendix II) were used to catch river catfish fry migrating back down stream. The start of the fry-catching season was linked to the arrival of highly turbid water from up stream (MRC 1992; cited by Phuong 1998). At Tan Chau and Hong Ngu in Viet Nam, this begins in early May and continues for two lunar cycles. The static fishing gear (or *dai* in Vietnamese) is generally placed 15-30 metres (and up to a maximum of 100 metres) from the riverbank in areas sheltered from wind and waves, with an even stream flow. Fry are classified by size and colour into three categories. These are 1.3-1.5 cm, 1.5-1.7 cm, and 1.7-2.0 cm, or silver, pink and black, respectively (Department of Freshwater Fisheries 1977; Department of Agriculture of An Giang province 1977; Tien 1995; cited by Khanh 1996).

Fine meshed nylon has been used for the bag net or *dai fishery*. In the process of catching catfish fry, unwanted fry of other species were also caught, which were then discarded. This made the fishery for river catfish fry highly destructive. An estimated 5-10 kg of other fish species were killed for each kilo of river catfish fry caught (Phuong 1998). The quantity of wild-caught river catfish fry declined tenfold in a decade because of over-fishing for fry (Department of Aquatic Natural Protection of Dong Thap province, cited by Khanh, 1996).

Recognition of this problem and the successful artificial spawning of river catfish led to the banning of the fishery for wild river catfish fry in both An Giang and Dong Thap provinces in February 2000 (see below for additional detail).

3. Status of hatchery seed production

Artificial propagation of river catfish was first achieved in Thailand in 1959 (Boonbrahm 1959, cited by Cacot 1999). Since then it has been done in Indonesia (Hardjamulia *et al.* 1981; cited by Cacot 1999) and in Malaysia (Thalathiah *et al.* 1983; cited by Cacot 1999).

Since 1978, research on artificial propagation of river catfish in Viet Nam has been undertaken by various institutions. These include the Fisheries Faculty, University of Agriculture No. 4, Thu Duc, Ho Chi Minh City, in cooperation with Long Dinh Agriculture Vocational School, Tien Giang province. The first fry were produced in 1979 and greater quantities of fry and fingerlings were produced over time. The Research Institute for Aquaculture No.2 (RIA 2) and Can Tho University, both began induced spawning trials with river catfish in 1981. The history of the successful development of artificial propagation techniques for river catfish over two decades is well documented in a Vietnamese-language doctoral thesis entitled "Induced spawning of the river catfish *Pangasianodon hypophthalmus* in the Mekong Delta" (Khanh 1996).

Sexual maturation of *P. hypophthalmus* takes more than three years. The development of the technique to remove oöcytes by intra-ovarian canulation and diameter measurement using a binocular microscope, in order to assess readiness of females for spawning, was vital to successful induced spawning of Pangasiids, and especially of *P. hypophthalmus* and *P. bocourti* (Cacot 1999).

In the 1980s, nursery survival rates of *P. hypophthalmus* were very low (<5%). Early researchers in Viet Nam thought that hatchling river catfish were initially too small to rear in earthen ponds. High mortality rates were caused by cannibalism and bacterial infection (*Aeromonas hydrophila*) – problems caused by rearing hatchlings at densities which were too high. Hung (2000) reported that hatchling river catfish had mouths large enough to take live feed such as *Cladocera* (*Moina* and *Daphnia*). Nursery survival rates were significantly improved by using such feed and by releasing hatchlings into earthen ponds within 20-24 hours of hatching. Today it is normal practice to stock hatchlings into properly-prepared earthen ponds just prior to yolk sac absorption. Thus natural feeds are immediately available when yolk sac absorption is complete. Also fry have enough space to avoid cannibalism (Hung 2000). Typical fry survival rates are now 60-70 percent.

As indicated in Table 1, Dong Thap Fish Experimental Station replicated the successful induced spawning of river catfish, producing 250 million fry in 2000 (Ro 2000). River catfish seed production has increased since artificial propagation became routine and both An Giang and Dong Thap provinces have banned the fishery for wild river catfish fry. As shown in Tables 1, 2 and 3, private seed producers have recently entered the river catfish seed market, with technical support provided by both the government and private companies. Today the private sector plays an important role in river catfish seed production. The Cai Be Research Center for Aquaculture in the Mekong delta, under RIA-2 (known as the Cai Be Fish Farm), has also become an important supplier of river catfish fry and fingerlings in Tien Giang province (Table 3).

Table 1 shows the number of river catfish fry and fingerlings produced annually in Dong Thap province, Table 2 shows the same data for AGIFISH of An Giang province and Table 3 the total production for the Viet Nam lower Mekong delta area.

Table 1 *P. hypophthalmus* seed production in Dong Thap province, 1998 -2000

Year	Number of producers	Broodstock		Fry (million)	Fingerlings (million)
		Number	Tonnes	Number	Number
1998	1	378	2.0	6	2.2
1999	17	3,000	12.0	350	150.0
2000	50	20,500	102.5	750	250.0

Source: Department of Natural Protection of Dong Thap Province, cited by Ro, 2000.

Table 2 Number of *P. hypophthalmus* fry produced by AGIFISH Co. (An Giang)

Year	Number of fry
1996	9,950
1997	1,850,000
1998	72,391,881
1999	93,272,400
2000*	24,218,259
Total	191,218,259

Note: * To September 2000.

Source: Hung 2000, AGIFISH Company, An Giang Province.

Table 3 Quantity of river catfish fry and fingerlings (mainly *P. hypophthalmus*), produced in the Mekong delta of Viet Nam

Producer	1998	1999
An Giang	80 million	>100 million
Dong Thap	20 million	>150 million*
Cai Be Research Center		20 million
Total	100 million	>270 million

Note: * Dong Thap Experimental Station on Aquatic Seed Production produced 20 million, four private farms produced the remainder.

Source: Nguyen Bang (1999).

Although Chau Thanh was the first (1997-98) major induced spawning area for *P. hypophthalmus* in Dong Thap province, spawning has since expanded rapidly and is now concentrated in Hong Ngu district. It supplies *P. hypophthalmus* and *P. bocourti* seed for intensive cage culture systems in Hong Ngu district adjacent to the border with Cambodia. Increasing numbers of hatcheries and nurseries supplying *Pangasiid* seed led to over-supply in 2000. The seed production network can now guarantee sufficient hatchery produced seed to meet the needs of the river catfish culture in the Mekong delta area of Viet Nam. It is claimed that only some 8-10 million *P. bocourti* are bought from Cambodia each year for use in cage culture, because hatchery production is not yet sufficient. However, many grow-out farmers believe riverine fish fry to be of superior quality.

4. Status of culture

Pangasiids are cultured both extensively and intensively in the Mekong delta, depending on feed availability, rearing systems and fish species. River catfish are generally cultured in pond and cage culture systems (Hung and Cacot 2000).

Most pond culture of river catfish is small-scale, so little statistical data are collected on pond production. Hung and Cacot (2000) estimate that production of river catfish in the delta is about 20,000 tonnes per year. Table 5 shows that pond production of river catfish in Dong Thap province increased from 3,000 to 4,500 tonnes from 1997 to 2000. Mean total pond production was 20-30 tonnes/ha/year, though a few ponds achieved production as high as 50 tonnes/ha/year. The 2000 Annual Reports of the Department of Agriculture of An Giang and Dong Thap provinces give a figure for cage culture production of 45,000 tonnes, which comprises almost equal amounts of *P. hypophthalmus* and *P. bocourti*, unlike the 1996 data presented in Figure 3, which show 85 percent *P. bocourti*.

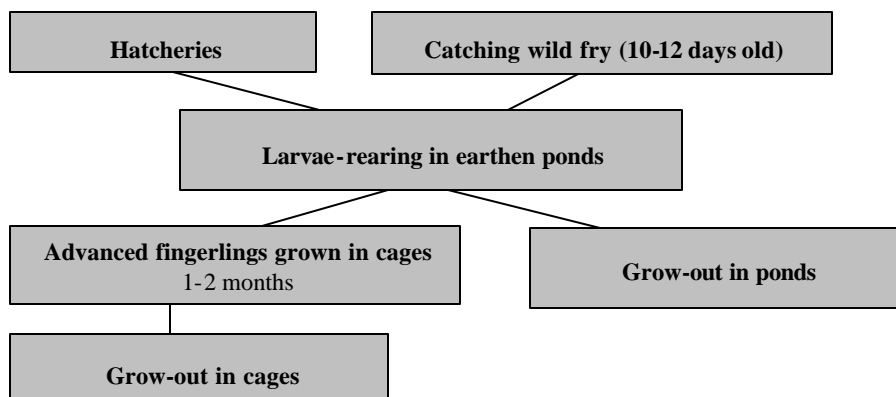
4.1 Pond culture

Wild-caught river catfish have traditionally been cultured in household ponds, throughout the Mekong delta area of Viet Nam, most commonly integrated with livestock, in order to utilise animal wastes.

According to Hung and Cacot (2000), river catfish are suitable for small-scale aquaculture systems and are often grown in polyculture, with Nile Tilapia (*Oreochromis niloticus*) and kissing gourami (*Helostoma temmincki*). Farmers collaborating in the last three years with the Rural Extension for Aquaculture Development (READ) Project in the Mekong Delta area have stocked river catfish in polyculture with 11 other fish species, including common carp, silver carp, Indian carp and silver barb. These are stocked in different proportions, depending on the agro-ecological zone, the availability of on-farm feeds and the socio-economic status of the household (READ 1998, 1999 and 2000). Because they air breath and can tolerate poor water quality, *P. hypophthalmus* are often stocked at densities as high as 20-25 fish per sq m, in both mono- and polyculture systems.

The production cycle of *P. hypophthalmus* comprises one single cycle in grow-out ponds (Figure 1). Fish are usually fed rice bran, broken rice, kitchen scraps and vegetables. In addition, river catfish feed on natural feed, which develops in ponds fertilised by animal wastes, including those of pigs and humans. Fish from integrated pond systems often have a muddy off-flavor and the flesh is always darker in colour than the flesh of river catfish reared in cages. Consumers, and the export market in particular, prefer the white coloured flesh of *P. hypophthalmus* reared in cages.

Figure 1 Production cycle for *P. hypophthalmus*



Source: Hung and Cacot 2000.

4.2. Cage culture

Cage culture started nearly a century ago in Cambodia (Chevey and Le Poulain 1940; Coche 1978; cited by Hung and Cacot 2000). It was introduced to Viet Nam when Vietnamese refugees fled Cambodia in the 1960s (MRC 1992). Since then, cage culture has continued to develop and is concentrated along the Vietnamese-Cambodian border in An Giang and Dong Thap provinces in Viet Nam (Phuong 1998). Figure 2 shows cage production from 1985 to 95 for An Giang and Dong Thap provinces.

Cage culture is an intensive culture system since fish are stocked at very high densities (100 kg/cu m) and artificial feed is provided as the only nutrient source for fish growth. *P. bocourti* is the main species cultured in cages, contributing 85 percent of the total cage production in the Mekong delta. Other *Pangasiids* reared in cages are *P. hypophthalmus*, *P. conchophilus*, *P. larnaudiei* and *P. conic*, and these contribute 6 percent of total cage production in Viet Nam (Figure 3). Spotted snakehead (*Channa micropeltes*) and other *Cyprinids*, such as silver barb (*Barbodes gonionotus*) and red-tail tin-foil barb (*B. altus*) contribute 5 percent and 4 percent, respectively, to total cage production (Hung and Cacot 2000).

Cage culture development is concentrated in An Giang and Dong Thap provinces in areas with suitable water currents and locally available supplies of seed and feed (Table 4). Good infrastructure (roads and waterways), credit systems and processing factories are also advantageous.

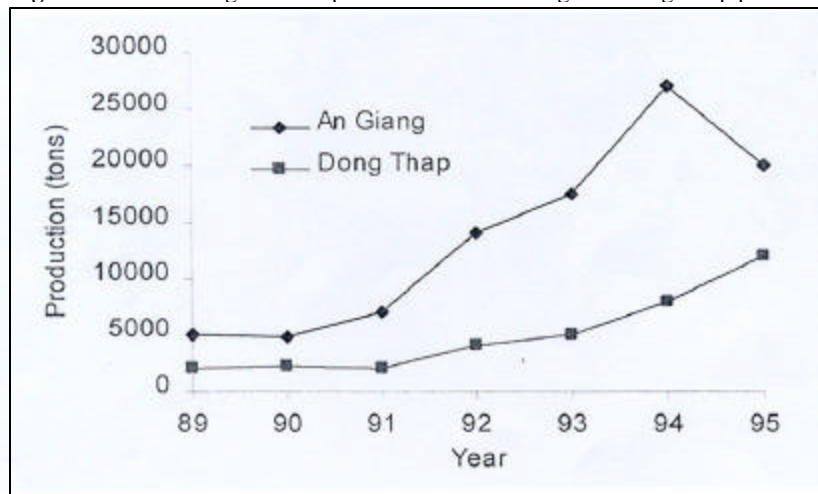
P. hypophthalmus is an omnivore that will feed on rice bran, broken rice and corn, cassava flour, trash fish, fish-meal and vegetables in culture systems. In Viet Nam, rice bran usually contributes two thirds of the diet during grow-out of *P. hypophthalmus*. Home-made feeds normally consist mainly of rice bran, broken rice, trash fish and vegetables. In Viet Nam, cage feeds are prepared, mixed and cooked at site, with the feed being presented as wet sticky balls.

Table 4 Number of cages in An Giang and Dong Thap provinces

Size categories	Household	State owned	Shareholding	Total
Small size	773	18	0	791
Medium size	787	0	0	787
Large size	564	21	35	620
Total	2,124	39	35	2,198

Source: Phuong 1998.

Figure 2 Annual cage culture production in An Giang and Dong Thap provinces



Source: Phuong 1998.

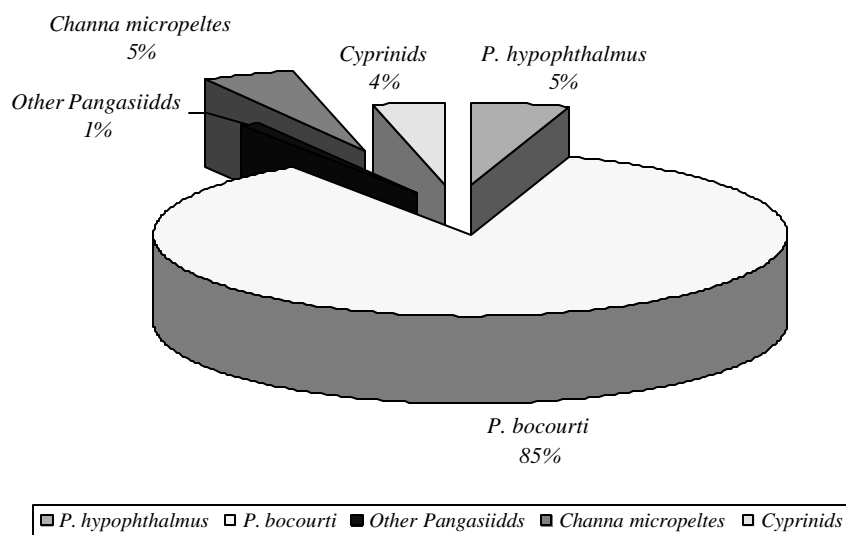
Figure 1 shows a diagrammatic representation of *P. hypophthalmus* cage culture. Fingerlings obtained from the nursing ponds are grown in small cages to advanced fingerlings of 100 g and these are stocked into grow-out cages. In Viet Nam, mean yield of *P. hypophthalmus* is 88 kg/cu m (Hung and Cacot 2000). Culture is concentrated in Hong Ngu and Tan Hong districts, though there has been a more recent spread to other areas, including Thanh Binh, Cao Lanh, and Sa Dec districts. Average production from grow-out cages is 80-120 kg/sq m/year (Table 5).

Table 5 Status of *P. hypophthalmus* pond culture in Dong Thap province

Year	No. of cages	Water area (ha)	Production (tonnes)		Total production (tonnes)
			In Cage	In Pond	
1997	86	150	2,300	3,000	5,300
1998	109	165	2,900	3,500	6,400
1999	120	180	3,600	4,100	8,100
2000	150	200	5,000	4,500	9,500

Source: Ro 2000.

Figure 3 Cage production proportion of different catfish species in the Mekong Delta, in 1996.



Source: Hung and Cacot 2000.

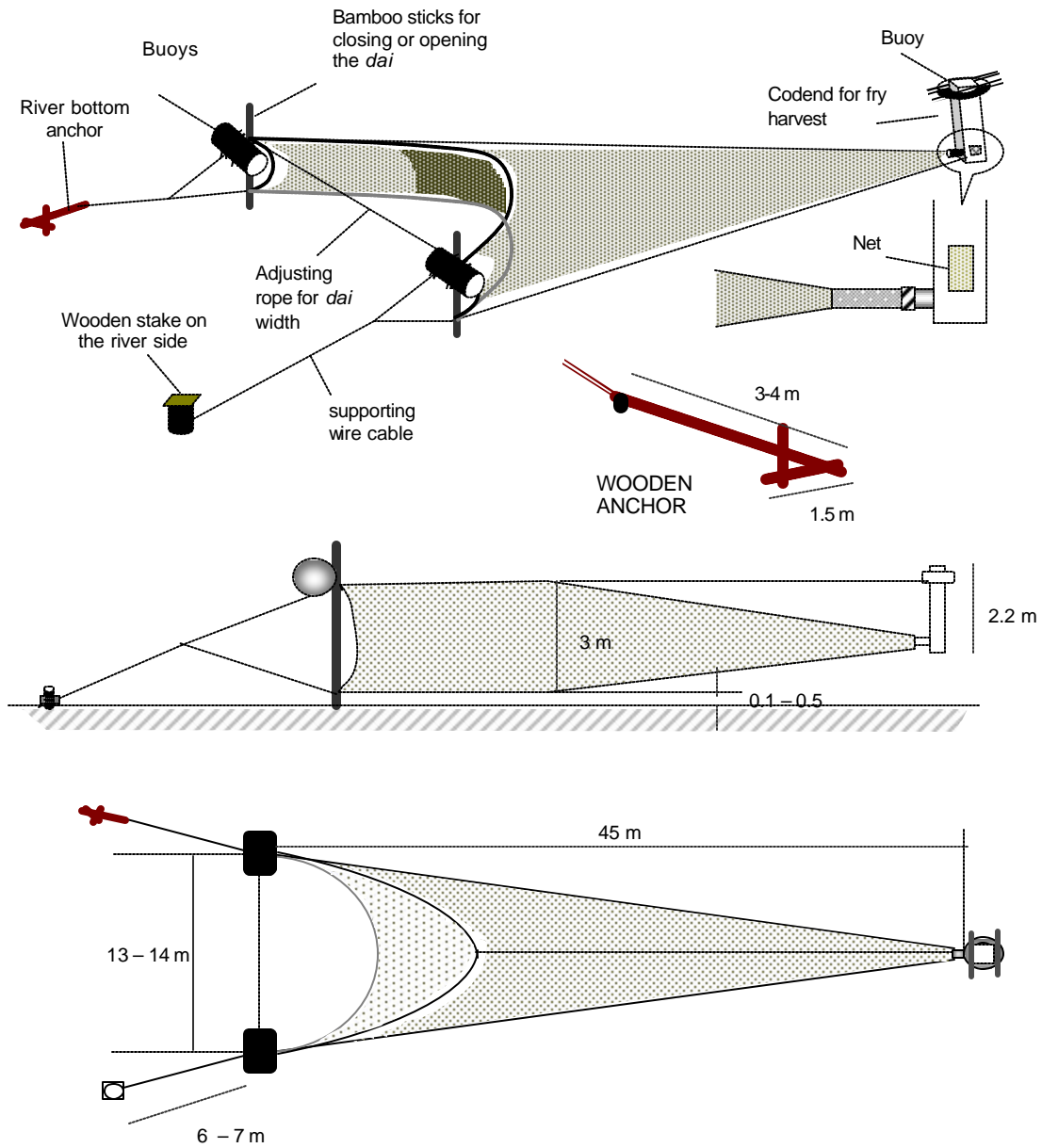
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Appendix I. Map of the Mekong river system and floodplains.



Appendix II. Bagnet or *dai* for catching Pangasiid fry, as used in Cambodia and Viet Nam



Source: Tung *et al.* 2000.

Appendix III Pictures of induced spawning of river catfish *Pangasianodon hypophthalmus*



River catfish *Pangasianodon hypophthalmus*
Checking spawning readiness and hormone injection.



Testis



Ovary



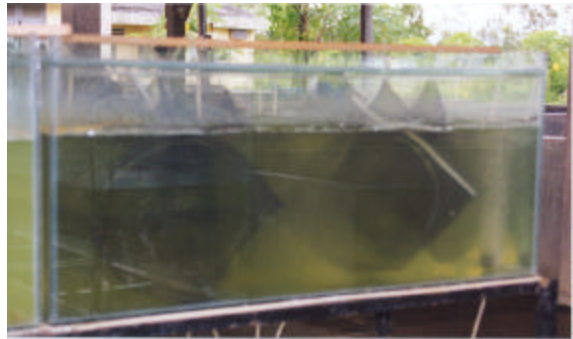
Stripping eggs



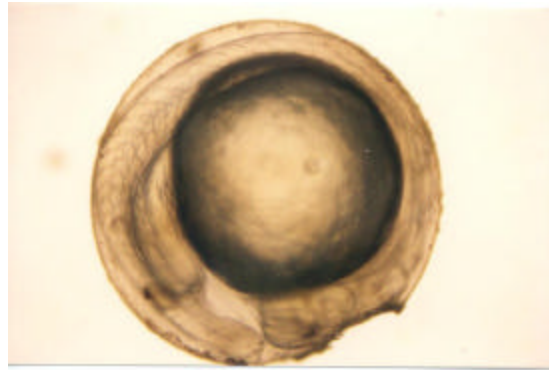
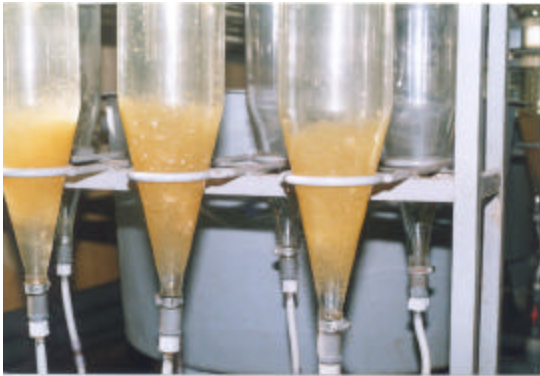
Stripping sperm



Fertilising the eggs

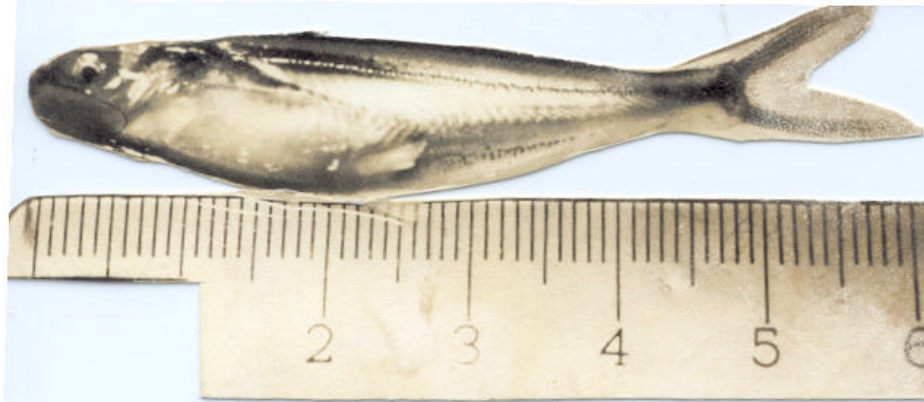


Incubating with different substrates (from left to right and top down: water hyacinth roots, nylon net in circulation tank and in an aquarium).



Incubating in Zuger jars (after removing stickiness)

Embryo



Fingerling

Appendix IV Pictures of river catfish *Pangasianodon hypophthalmus* grow-out



Cage culture



Harvesting river catfish from a polyculture pond – READ on-farm trial