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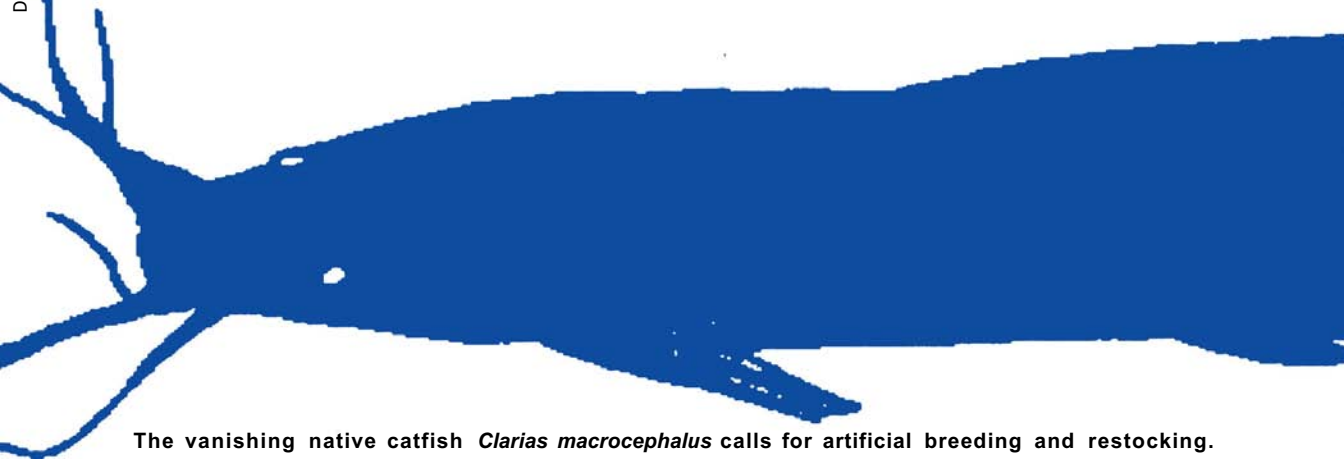
Catfish Culture

Research at SEAFDEC Aquaculture Department has dealt mainly with milkfish and other fishes and only recently with catfish. ADSEA II (*Seminar-Workshop on Aquaculture Development in Southeast Asia,* August 1991) and the SEAFDEC Member Countries placed catfish at a tow No. 8 among the research priorities. The literature on catfish culture is limited and outdated ('60s and early 70s). And the promise of a catfish culture industry in the Philippines remains to be fulfilled.

Farming catfish is easy. The *Clarias* species have special "talents":

- They have accessory organs for air-breathing and can survive under adverse conditions even in dry pools.
- They thrive in all kinds of freshwater habitats such as marshes, ricefields, swamps, streams, rivers, lakes, and irrigation canals.
- They are tolerant to crowding and can be raised at extremely high stocking rates on artificial feeds. (Less land is required for catfish culture.)
- Delicacies in Asian and other countries, they have high export potential.

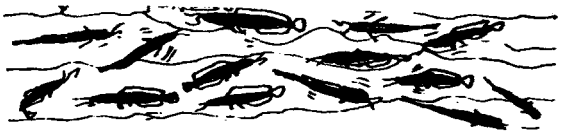
The catfish culture industry needs considerable R & D to solve its problems. Continuing studies at SEAFDEC/AQD are aimed at solving many of these problems to propel the industry forward.



The vanishing native catfish *Clarias macrocephalus* calls for artificial breeding and restocking.

Status of catfish culture

Catfishes belonging to the families Ictaluridae, Clariidae, Pangasidae and Siluridae are widely distributed in different parts of the world, and their culture has been a tradition in some parts of South and Southeast Asia. Catfish are also valued for recreational fishing in southern USA. The recent interest in commercial farming was largely generated by the development of a multimillion dollar catfish farming industry in southern USA. Since the 1900s, considerable research and development have been directed towards catfish farming and the processing and promotion of catfish products. Channel catfish, the main species farmed in the USA, have been transplanted to a number of countries in southern Europe, Africa and Central America, but no comparable enterprises have developed in these regions. Farming local species of catfish is a trend in many countries.



Philippines

Two catfish species are cultured in the Philippines: the local *Clarias macrocephalus* and the imported *Clarias batrachus—hito* to Tagalogs, *paltat* to Ilocanos, *ito* to Pampangos, *pantat* to Cebuanos and Ilonggos. The more acceptable species is *C. macrocephalus,* relished for its tender flesh and delicious taste. *C. batrachus* grows larger and faster but has a lower market value than the local species.

Most of those who go into catfish raising depend on limited natural sources for fry. But with proper planning and management, some *hito* farmers produce their own seed. In 1973, the Agro-Fisheries Group in Los Baños, Laguna responded to the problem of fingerling supply by importing *C. batrachus* from Thailand.

The stocking rate in ponds depends on the size of fish and the water depth. It is best to stock in the later afternoon or early morning when it is cool. Catfish grow to market size in 5-6 months.

Size of fish stocked	*Number of fish per m²*	*Duration of culture (months)*
3- 4cm	80 to 100	5 to 6
5- 6cm	60 to 80	4 to 5
7-10 cm	40 to 60	3 to 4

There are many catfish collection grounds in the Philippines, including Candaba Swamp, Mangabul Marsh, Laguna de Bay, the Bicol Region, Naujan Lake in Mindoro, Panay, Liguasan Marsh, and Bulusan Lake.

The Philippines exported 776 134 kg of catfish worth ₱ 29.5 million to 13 countries in 1986. The three major importers were the USA, Singapore and Canada.

Sources: (1) RR Radan. *The culture of catfish.* **Greenfields** undated. (2) S Hara. 1977. *The culture of catfish Clarias macrocephalus Gunther.* **Japan Overseas Cooperation Volunteers Philippines**. (3) *Earn from catfish farming.* **AGRISCOPE** Vol. I (II) 1987.

Thailand

Clarias farming in Thailand has developed during the last 15 years to become an important aquaculture system. The current production of farmed *C. batrachus* and *C. macrocephalus* amounts to about 10 000 MT per year at a farm gate value of around US$10 million. This exceeds the production through aquaculture of any other species in Thailand. *Clarias* is stocked at a very high density, generally from 80 to 160 fry/m², but sometimes up to 300/m² or more. Since the fish can breathe air and are fed "complete" feeds, the high densities do not restrict growth. As a result, the annual yield per unit area from 2 or 3 crops a year is very high, reaching an average 200 MT per hectare. Yields of this order are usually obtained only in running-water systems or cages such as for trout and carp in Japan. In Thailand, however, this high yield is obtained in ponds where water exchange is limited. No other pond system produces such

high yields. No doubt the development of *Clarias* culture in Thailand is one of the major achievements of aquaculture in the last decade.

Source: B Hepher. 1981. **Management and Research Approaches In *Clarias* Culture,** Thailand. DOF Thai-UNDP/FAO.

For grow-out of *C. batrachus,* small ponds (200-1000m^2) are used. Normally the ponds are not fertilized, but between crops the ponds are dried and occasionally treated with light doses of lime. They are fled to a depth of 50-80 cm. Stocking is in March or April and the first harvest in July or August The ponds are stocked again between Jury and September for a second crop. In order to avoid the period when wild-caught catfish are available in the market, the second harvest may be delayed until the following February or March. The average yield of *Clarias* in Thailand is 29-32.6 tons per hectare per year. A production of up to 100 tons per hectare per every four months has been reported.

Cambodia

Cage culture of *Pangasius* is common in Kampuchea, Thailand, and recently in Vietnam.

In Kampuchea, cages are made of bamboo poles and splints. They are box-shaped when installed separately but when trailed behind a fisherman's boat, as is often done, they are arranged to fit the shape of the boat. The sizes vary considerably, but the larger cages are 40-50 meters long, 4-5 meters wide and 2.5-3.0 meters high. Small cages are 4 x 4 x 2.5 meters. A number of small cages may be lashed together, buoyed with air-tight metal drums, and provided with walkways for feeding, harvest, and maintenance work.

The cages are stocked with wild fry or fingerings. A large cage may be stocked with 6000 -10 000 fry in June to August. They are fed cooked vegetables like pumpkin, banana and a combination of cooked rice and rice bran. As the catfish grow, they are fed live and dead fish pests and kitchen refuse. Harvest is in February to May when the catfish have grown to 1.5-2.5 kg each.

Vietnam

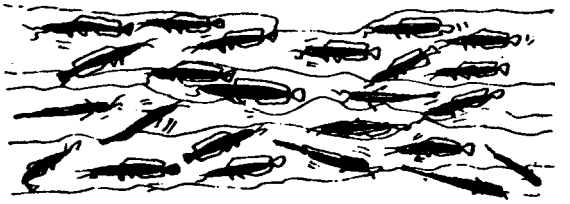
Box-shaped cages are made of wooden planks with mesh-wire panels on the sides for free water flow. There is a floating cabin on the cage farm for the owner or caretaker to live in. The whole installation is moored in the river near the shore, or secured directly to the shore. Cages are stocked with fry 4-6 cm long from August to October. Sometimes, bigger fry from rice fields or rivers are used. The stocking density is about 93 fry/m^3. *Pangasius* are fed vegetable matter such as chopped leaves, rice bran and forage fish. These may be supplemented with cooked or uncooked meat of mussels, snails, etc. Harvest is in March to August, after a culture period of over 10 months. The production ranges from 3000 to 25 000 kg per year per cage of 1600 m^3 capacity.

Africa

Clarias lazera (= *gariepinus*), known as the African catfish, sharp-tooth catfish, or the Nile catfish, is a recent addition to aquaculture in Africa, which has been largely dominated by tilapia. Catfish culture is presently restricted to the Ivory Coast and, on an experimental scale, to Egypt. Other catfishes such as the *Chrysichthys* species are also being tested in ponds and cages.

Clarias lazera is an omnivore, feeding on vegetable matter, aquatic invertebrates, small fish, and detritus. This catfish species can reach about 1.5 meters and 13 kg in size. It grows in freshwater and in salinities of 10 to 29 ppt.

The African catfish are grown in monoculture or in polyculture with tilapia in ponds. High-density tank culture has not yet been adopted on a commercial scale.



Channel catfish farming

Infofish Marketing Digest (No. 4/86) cited FAO figures to show the extent of catfish (*Ictalurus*) farming in North America:

	1980	1981	1982	1983
Canada	585	689	513	500
Mexico	421	148	337	547
USA	13 091	14 810	16 264	1539
Total	**14 097**	**15 647**	**17 114**	**16 438**

Europe

The European catfish, *Silurus glanis*, known also as the sheatfish or wels, is a highly relished fish particularly in the eastern and central Europe. Besides the taste, the high deboned weight (66%) and the absence of intramuscular bones make *S. glanis* especially valuable for filleting and processing.

Silurus is highly voracious, feeding on fish and other aquatic animals. In fact, its culture started with its use as a predator in carp ponds to control pest fish. Later, its was stocked in recreational waters. In recent years, efforts have been directed towards monoculture in ponds and cages.

Small ponds rich in plankton are stocked at the rate of 10-15 fry per m^2. They are fed pellets or ground fresh meat or fish several times a day. Fingerlings have been raised very successfully up to 6 months on trout starter-feeds and pellets.

Yearlings can also be grown in polyculture in carp ponds. Fingerlings of both carp and sheatfish, weighing 25-30 grams, are reared together at stocking rates of 3000-5000 per hectare. Reared for almost 2 years, they weigh 900-1100 grams at harvest.

United States

The most important species is the channel catfish (*Ictalurus punctatus*). The white catfish (*I. catus*), which is more tolerant to crowding, higher temperature and low oxygen levels, and the blue catfish (*I. furcatus*), which grows more uniformly also have farming potential.

Raceways are used in intensive catfish culture. Raceways are constructed of concrete, asphalt, concrete blocks or earth. Production intensity depends largely on the. water supply. Smaller raceways with high-volume and high-velocity water supply are used for highly intensive production, whereas larger raceways with a lower water flow are used in semi-intensive systems. A recent development is the use of circular and linear tanks.

A culture system of some importance is the so-called fee-lakes, pay-lakes or put-and-take fishing. Operators of such establishments produce their own fingerlings or get them from other hatcheries. People are allowed to fish in these waters for a fee, based on the quantity of fish caught or the duration of recreational fishing.

Grow-out of channel catfish to market size takes a little less than two years after hatching, or one year from the fingerling stage. The usual market size is 500 grams to 1.4 kg, but many are harvested at 450 to 600 grams. Fingerlings are generally stocked in spring and harvested in October-November.

Catfish culture techniques vary between farms depending on the location and culture system. Pond farming is probably the most profitable, larger farms more so than smaller ones. Production has to be at least 1500-2200 kg per hectare to make a profit. Some farmers rotate rice, catfish and soybeans to obtain better returns. The agronomic crops benefit from the improved nutrient level of the soil due to the feces and unconsumed feeds from the fish stock.

Source: TVR Pillay.1990. **Aquaculture Principles and Practices.** Fishing News (Books).

Support sustainable aquaculture

Farming systems

Farming systems for catfish include ponds, cages, raceways, and tanks.

Pond culture

The suitability of land for the catfish *Ictalurus punctatus* should be seriously studied. Soil of high clay content is considered the best. The size of the pond depends on the grower's willingness to meet construction costs and the type and extent of his intended operations. Ponds should be rectangular in shape, twice as long as wide. The shallow end should be 0.75-1 meter deep, sloping to 1.5-2 meter deep.

Prior to stocking, grow-out ponds are prepared for the production of natural food. Fish pests are destroyed with 0.5-2.0 ppm rotenone several weeks before stocking. Rotenone may remain toxic for two weeks in warm water and longer in cold water. Pond bottom should be dried and smoothed. After filling with water, fertilize the ponds, especially new ponds, with 16-20-4 or 16-20-0 fertilizer at the rate of 50 kg per hectare.

Selection of fingerlings

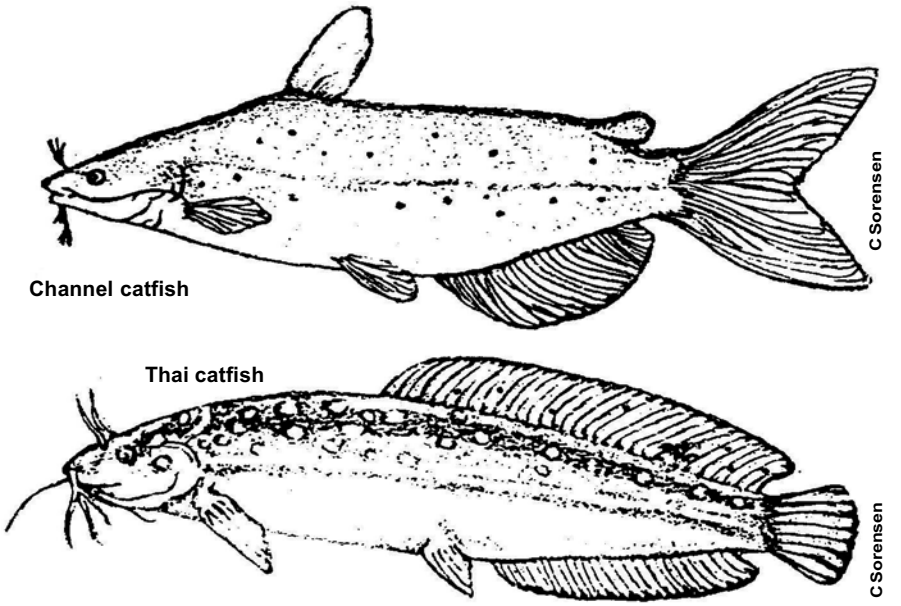
Fingerlings should be of uniform size and in good health. If fingerlings are purchased, it is a good idea to buy from reputable producers.

Most growers prefer to stock 15 cm fingerlings. Fish should weigh half a kilogram in 210 days, or by October or November. Larger fingerlings of about 20 cm long are preferred by some growers who can pay the higher price. Fingerling under 10 cm should not be used.

Stocking

It is better to stock ponds during the warmer months. In cold countries, winter months are least preferable for stocking because the activity of catfish is at a minimum and they may not start to feed right away. Getting fingerlings to feed immediately after stocking is critical.

Stocking rate varies with the size of fish desired and the culture practice. The holding capacity of ponds is limited by the available oxygen and competition by plants and animals. Fingerlings are stocked at 1875-2500 per hectare in ponds that depend on rain and runoff. Higher stocking densities (3750-5000) are possible if a pump is used for water exchange.



The channel catfish *Ictalurus punctatus* is the most widely cultured species In North America. In the Philippines on the other hand, farming the fast-growing Thai catfish C *batrachus* has become popular.

Source: ***World Aquaculture*** 22 (2), June 1991.

Feeding

The amount of feed consumed by fish varies with temperature and other conditions. Catfish consumes the most feed and grows best at 27 to 29°C. Fish should not be fed more than the amount consumed in 10-15 min. Overfeeding causes more trouble than any other practice. Catfish are fed at the rate of 3% of the fish weight at each feeding. Some growers feed every day, others omit feeding one day each week.

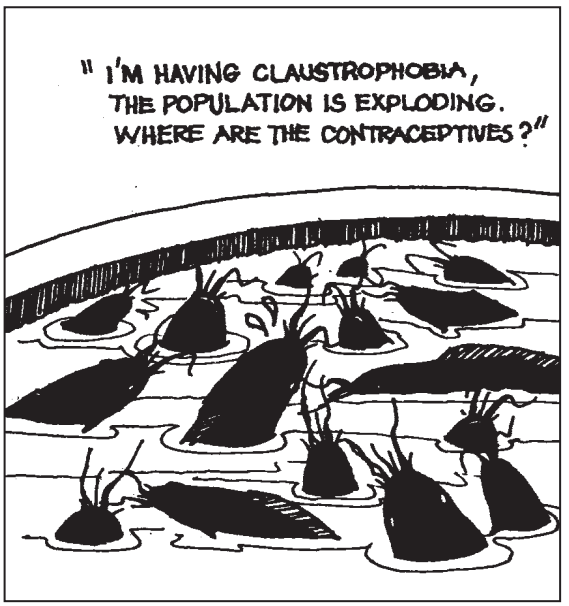
Catfish requires a high protein diet (35-40%). The feed includes an attractant to ensure that the fish will eat it. One of the better known basic formulas consists of the following:

Soybean oil meal	**35%**
Peanut cake	**35%**
Fish meal	**15%**
Distillers' dry solubles	**15%**

These various components are blended and then pelletted, about 4-10 mm in diameter. Catfish will eat either a sinking or a floating feed.

Water quality

Water quality has much to do with the well-being of the fish. Insufficient oxygen affects production. Oxygen deficiencies most often occur just before sunrise. Overfeeding contributes to oxygen deficiency and to plankton blooms in stagnant ponds.



Techniques to cope with oxygen depletion include draining the water and adding fresh water, spraying water into the air to absorb oxygen, and placing aerators in ponds.

Other water quality variables such as ammonia and sulfide must remain well within tolerable limits.

Harvest

The pond is drained when complete harvest is desired. Ponds are constructed with a harvest or catch basin to facilitate draining of the water. The fish are removed with scoop nets and placed in transport tanks.

The draining method is applicable in small ponds. One major disadvantage is that water is wasted. Before another fish crop can be grown, the pond must be filled. Concentrating catfish into a small area increases the danger of oxygen depletion, especially during warm summer days. Several hours, or even days, may be required to drain a pond. The advantage of complete draining is that the pond bottom can be dried and smoothed for the growing season. Draining is most efficient for total harvest.

Seining permits the harvest of entire ponds without water drawdown. This method may be used to harvest large ponds up to 40 hectares or more and requires a greater investment on equipment. In North America, power equipment is used, thus reducing manual labor. Not all fish are captured, as 15-20% could escape.

Cage culture

Design of cages

Cages should be constructed of materials that are sturdy, relatively lightweight, rust and corrosion resistant, and slow to decay in water. Floating materials include expanded polyurethane foam, expanded polystyrene and styrofoam. These are dissolved by oil or gasoline and, therefore, should be coated with fiberglass if there is a possibility of contact with liquid or

petroleum products. Some commercial cages are constructed for easy disassembly.

Cages for the catfish *Ictalurus punctatus* are constructed in various sizes and materials. Most cages are designed to a capacity of 1 metric ton. Cage dimensions of 1 × 1 × 1 meter have been used. Larger cages of 6-7 tons capacity are better than smaller cages.

Cages are constructed of wooden, plastic or metal frames and lined with aluminum, nylon, or polypropylene net. Some cages are constructed of galvanized welded wire with a 1 × 2 cm mesh. A 16-gauge wire is common. Treating zinc-coated wire with tar or asphalt can prevent zinc poisoning and decay. Mesh sizes of other materials vary from 0.3-1 cm. The top of cages may be covered with wood or fine net.

Cage design should facilitate easy entry of technicians but prevent theft and unwanted disturbance to the fish. Cages may be connected by a floating platform or bars. Floating platforms are preferred by some farmers, and these are built to support one or two men, thus facilitating feeding and observation.

Water movement causes feeds to drift out of cages. Feed rings may be made of wood or file screen to prevent loss of feeds.

Rate of stocking

The Ending factor in stocking fish is the amount of dissolved oxygen in the water. A stocking rate designed to produce680-900kg of food fish is suggested. Frequently, 150 to 200 catfish 13-18 cm long are stocked per cage in early spring or in fall.

Feeding

Catfish depend almost entirely on feeds supplied by the farmer. The supplemental feed normally available to catfish in ponds and streams is not available in cages. A nutritionally complete floating feed is preferred.

Feeding rate varies. For newly stocked fish, 3.5% of fish weight per day will suffice. This can be gradually reduced to 2.5% or less depending on how much the fish actually consume.

Fish in cages grow more rapidly if fed twice daily than if fed once each day, but the difference in weight gain is not sufficient to justify feeding twice daily. Late afternoon is the best time to feed. Feed should be placed inside the cages. Catfish should be fed no more than they will consume in 30 minutes. Catfish may not consume feed shortly after a major weather change.

Culture in raceways

True raceways are relatively small, about 500-2500 m^2. The water exchange is twice each hour. The amount of fish produced is much greater than in a pond of similar size. The water in true raceways flows much more rapidly and is exchanged more often (turns over twice per hour) than in semi-raceways. Semi-raceways are usually larger and do not produce as much fish per acre as true raceways.

Growing the catfish *Ictalurus punctatus* in raceways is still experimental and should be tried with caution.

Stocking rate

The stocking rate is based on the size of fish desired at marketing and the flow of water.

A common rate is based on 8 kg of fish per ton of water. For example, a raceway with 112 tons can be stocked with 2000 fingerlings. With proper feeding, 900 kg of fish can be produced in 180 to 210 days. Another rate of stocking is 125 000- 150 000 per ha. Most individual raceways are less than 400 m^2; the number of fingerlings to stock must be calculated accordingly.

The stocking rate in semi-raceways is considerably less than in raceways. Some raceways or semi-raceways with water flows of 600 liters per min can be stocked with 3500 to 5000 fingerlings 15 cm long.

Feeding

Catfish grown in raceways require a complete feed (pellets) more nutritious than that used in ponds. The density of fish population in raceways is much greater and the water does not contain zooplankton.

A floating feed is preferred. Feeding rate is usually 4-5% of fish weight for 60 days after stocking. This rate is gradually reduced to 3%.

About 1 /3 of the daily amount may be given in the early morning and 2/3 in late afternoon. No more than 450 grams of feed may be used per 3 tons of water.

Culture in tank

Tank culture of the catfish *Ictalurus punctatus* is new but farmers who have used tanks have been pleased with the results. A round tank 6 meters in diameter and 0.6 meter deep is equivalent to a half-hectare pond.

Rate of stocking

Fingerlings stocked are usually 15-20 cm long. Stocking rate may range from 180 to 530 fingerlings per ton of water. The best stocking rate depends on waterflow and aeration rates. As stocking rates are increased, production increases — if growth rates and survival are kept high. When an factors are considered, the best stocking rate may be 180-350 fish per ton when a size of 600-800 grams each is desired.

Feeding

Floating feed is often used. The feed should be nutritionally complete and should contain more vitamins than the feed for pond systems. Fish in tanks are often fed by hand two to three times daily. Rate of feeding is gauged by the amount of feed consumed. A daily level of around 3% of fish weight is used. Overfeeding should be avoided to minimize waste. Some producers have found that production is increased significantly when the tanks are protected from bright light either by covering the tanks or locating them inside a building.

Source: Training notes of the Network of Aquaculture Centres in Asia and SEAFDEC/AQD. 1981-87.

Support sustainable aquaculture

Industry practices and problems

Toward adequate seed supply

The present supply of *hito* fingerlings in the Philippines is very limited and cannot totally meet the demands of the increasing number of farmers. Every year, *hito* fry are gathered from their natural habitat - rice paddies, swamps, irrigation canals, marshes - and stocked in ponds. This practice is expensive due to heavy mortality during transport and stocking. There is also uncertainty in the availability of fry at the proper time. These problems of seed supply prompted several experiments on induced spawning.

Mature and gravid females are selected. The hormone gonadotropin and commercial preparations such as synahorin can be used. A dose of 500 IU per breeder is sufficient. A 0.6% saline solution can be used for fertilization. Japanese technicians use Ringer's solution but buying, preparing and preserving the chemicals to compose the solution requires knowledge in chemistry which ordinary fish farmers and small-scale culturists do not have. Saline solution is available in local drug stores.

Local materials such as baking pans, water basins saucer plates, and duck feathers can be used in artificial spawning.

Production of catfish fry is possible anytime of the year. This, however, depends on : (1) water pH, 7.5-8 being ideal; (2) water temperature, 26-30°C; and (3) sufficient oxygen supply. There should be a dependable water source for continuous inflow of water. Water is not chlorinated, otherwise hatching of eggs is inhibited.

Troughs are used for incubation, hatching and larval rearing. They must be flushed regularly to combat growth of fungi and the spread of diseases and parasites. Sufficient agitation should be provided to aerate the entire egg mass. Fry are sensitive to shock and should be handled carefully.

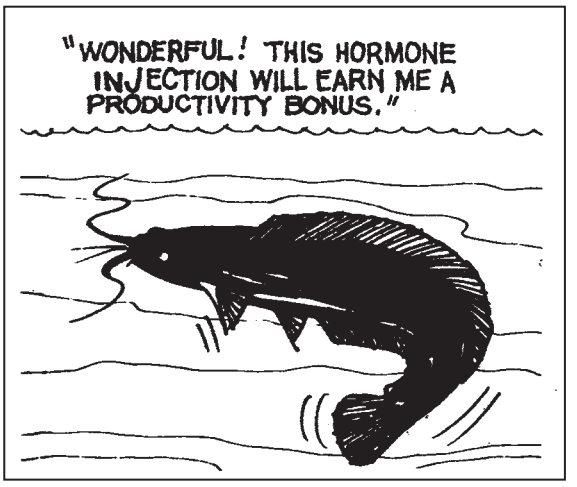
Source: WR Rosario. 1980. *Induced spawning of freshwater catfish (Clarias macrocephalus) using local materials and 0.6% saline solution.* **PSU Research Journal** V.1(1):pp.31-41.Pangasinan State University. Pangasinan.

Spawning by hormone injection may happen spontaneously, or may be done by stripping. Gravid or pregnant females and healthy, mature males weighing at least 200 grams are used. The gravid *hito* has a distended abdomen, the genital part pinkish, and the blood vessels on its belly prominent. Breeders should be conditioned first in concrete or semi-concrete tanks or vats 2 to 5 months before they are injected with hormone.

The natural method entails injecting hormones into gravid females and males near the anus. Gonadotropin, synahorin or fresh hormone extracts from pituitary glands of fish may be used. Each female *hito* should receive 200 to 250 IU (international units) of gonadotropin, and each male, 50 IU. Wrap fish in a small net so they struggle less during injection. After injection, put the male and female together in a tank with oxygenated water and improvised nest made of cabo negro (black palm fibers).

The stripping method entails the sacrifice of several males. Remove the pinkish yellow testes and extract sperm by macerating the testes in distilled water.

Inject hormone into the gravid female, a little above lateral line. Use this dosage: gonadotropin, 750 to 1500 IU; synahorin, 1000 to 1500 IU. After 12 hours, squeeze the female's abdomen to force the eggs out. A 250 gram



female produces 8000 to 15000 eggs. Mix eggs with sperm and stir for a minute. Spread eggs thinly in hatching troughs with running water at temperatures 26-36°C. Eggs hatch 24-36 hours later.

Transfer hatched larvae into basins half-filled with water. The young fish will absorb all the yolk in 5 days, then begin to swim actively and take food.

About 15 000 - 20 000 fry can be reared in a space of 1 × 3 × 6 meters. Zooplankton are the best food for the fry at the early stage. Peanut cake may be supplemented in the diet. After one week, fry should have grown to 1.5-4.3 cm long.

Tackling high feed cost

Although it eats almost anything, *hito* prefers fishes and animal carcass. If raised on a low-protein diet, it grows very slow with a head much larger than the rest of its body. Its meat becomes tough and leathery which may not be acceptable to consumers. Thus, the feed should be 90% meat and may be fresh trash fish, worms, insects, slaughterhouse by-products, chicken entrails, dried or fresh water shrimp, fish offal, the golden kuhol, and by-products of canning factories. The remaining 10% is composed of boiled broken rice mixed with vegetables or rice bran. To augment food supply, install a strong light over the pond to attract insects at night.

Feed the catfish twice a day. To avoid waste, give the feed slowly, handful by handful, until the fish stop eating. Daily feed ration is 6-7% of the fish body weight. If the fish remain small, provide 30 kg of manure.

Remember that catfish are cannibalistic and quarrelsome. If the larger fish are very hungry, they gobble up the smaller ones as quickly as any other food that come their way.

Preventing and controlling diseases

Parasites and bacterial infections, and nutritional diseases have been reported for the waking catfish in Thailand. High-density culture of *Clarias* is conducive to high incidence of disease that often decimates half the stock. The three most common diseases of cultured catfish are *Trichodina* infection of the gills, bacterial infection of the kidney and *Gyrodactylus* infection. Infections by *Aeromonas* spp., *Flavobacterium* spp., *Flexibacter columnaris, Pseudomonas spp.* and *Edwardsiella tarda* have been identified in *C. batrachus* and *C. macrocephalus.*

Aeromonas infection is characterized by distended abdomen filled with opaque or bloody fluid, red spots on the body, stomach filled with yellow mucus, swollen kidneys, eroded fins, inflamed mouth, pale or green fiver and excess secretion of mucus. When catfish lose their balance, are pale, with distended abdomen filled with bloody excretion, they are infected with *Pseudomonas.*

Most of these infections are brought in with the fry or fingerlings, or by diseased frogs. Treatment with 25-50 ppm formalin in the pond or a one-hour bath of 250 ppm formalin in tanks is recommended before the fry or fingerlings are stocked.

Most diseases can be minimized through proper management of the culture system and the avoidance of stress. Two of the most common types of stress are related to abrupt temperature changes and exposure to low dissolved oxygen levels. If fish are moved from one temperature to another, they should be allowed to do so gradually, ideally not more than a degree centigrade or two hourly.

Accumulation of hydrogen sulfide is another cause of mortality in *Clarias* ponds. Dissolved oxygen levels do not appear to be so

critical for the survival and growth of the species.

In Pangasinan and Mindoro (Philippines), *C. batrachus and C. macrocephalus* are noted to be susceptible to the epizootic ulcerative syndrome (EUS). EUS is characterized by skin and muscle lesions and bulging eyes and occurs during the cold months of the year. SEAFDEC/AQD has been conducting studies on the etiology and histopathology of EUS in the snakehead *Ophicephalus striates.*

Diseases of channel catfish

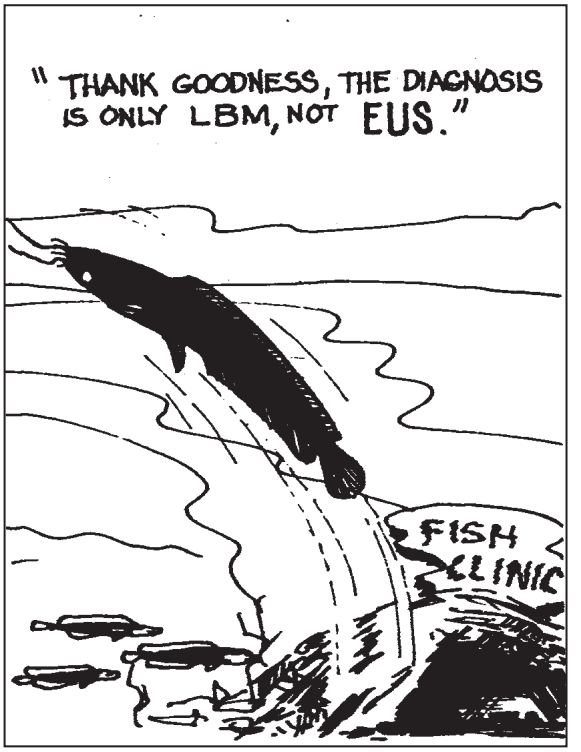
The channel catfish virus disease (CCVD) may cause large losses of fingerlings in a short time. Like most viral diseases, the only means known of eliminating CCVD is the destruction of all infected broodstock. Hemorrhagic septicemia and columnaris disease are bacterial diseases that also cause considerable mortality. A variety of protozoans also infect catfish; of these, ichthyophthiriasis or 'ich' is the most harmful. Eradication of the parasite is possible only during Is free-swimming stage and repeated treatments over a period of days or weeks are needed. Costiasis is another common protozoan infection among fingerlings.

Various species of the external parasite *Trichodina* affect channel catfish. They occur on the body, fins and gifts. Trichodiniasis is characterized by irregular white blotches on the head and back, frayed fins, loss of appetite, and excessive production of mucus. Dips in 30 ppt salt water, a 1:500 solution of acetic acid, or a 1:4000 solution of formalin are the usual treatments.

Myxosporidian parasites of the genus *Henneguya,* monogenetic trematode *Gyrodactylus* and the copepod parasites *Ergasilus, Argulus* and *Lernaea* can cause mortality.

A relatively small percentage of fish farmers experience serious disease problems within a given year, but nearly all farms have occasional problems. In the United States, formalin has recently been approved for use on catfish as well as trout, salmon, largemouth bass, and bluegill. The antibiotic Terramycin (Oxytetracycline) was approved in the early 1970s and is effective against various bacteria.

The most common preventive treatment applied to catfish is during egg incubation when fungus problems are common. Antiseptic solutions of 1% Betadine have been used in 10-min irnmersion dips with some success. Some catfish farmers routinely offer feed containing Terramycin. This practice is discouraged because bacteria can become resistant to the antibiotic. Medicated feed may be used only when a bacterial infection has been found. Diseases usually appear 3 to 14 days after being stressed.



Some diseases of catfish are due to poor water quality (such as nitrite or ammonia toxicity) or poor nutrition, Vitamin C deficiency leads to deformities and, in severe cases, fracturing of the spinal column. Other vitamin deficiencies can lead to anemia, deformation of the gills, and other organ damage. Any nutritional deficiency leads to poor growth and feed conversion, and is a stress that opens the way for bacteria, parasites, and other secondary infections.

Sources: (1) **Agriscope** Vol. 1 No.11967. (2)TVR Pillay. 1990. **Aquaculture Principle and Practice.** Fishing News (Books). (3) RR Stickney. *Catfish culture.* **World Aquaculture.** Vol. 22 (2). June 1991. (4) 1991 and 1992-93 reports of SEAFDEC Aquaculture Department

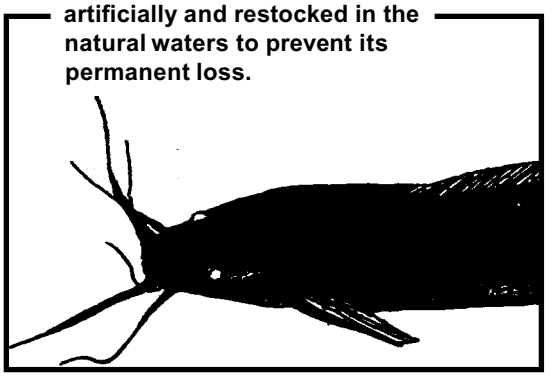
... at the SEAFDEC Aquaculture Department

Induced spawning of the native catfish

Pituitary extracts, human chorionic gonadotropin (hCG), corticosteroids or luteinizing hormone-releasing hormone analogues (LHRHa) have been used to induce spawning of the captive native catfish *Clarias macrocephalus.* These spawning agents are either difficult to quantify (pituitary extracts), expensive (hCG), or ineffective (corticosteroids or LHRHa alone). To find a cheaper yet more effective substitute, LHRHa at varying doses (0.025, 0.05, 0.10 μg per gram body weight) in combination with pimozide (1 μg per gram body weight), a dopamine antagonist, were tested on catfish.

Native catfish were collected from rivers in Iloilo and then stocked in 9.5 x 1.5 x 1 meter concrete tanks with a mud bottom. The fish were maintained under natural light cycle and fed trash fish daily at 5% of their body weight A day before the experiment, 23 gravid females averaging 110 grams were anesthetized and placed separately in 60-liter fiberglass tanks with water at 30-31°C. Fifteen male catfish were also placed in a one-ton tank. One hour before females were stripped of eggs, the males were killed to remove the testes. Catfish milt could not be obtained by simply pressing the abdomen.

The native catfish *Clarias macrocephalus* must be bred artificially and restocked in the natural waters to prevent its permanent loss.



LHRHa was dissolved in 0.9% sodium chloride, pimozide in dimethylsulfoxide, and propylene glycol was added at 1:9 by volume. The hormone preparations were freshly prepared and injected into all females simultaneously at 1800-1900 H on both sides of the back.

Egg diameter was determined before treatment. The eggs were obtained from the ovary by aspirating with a silastic medical grade tubing. At least 20 eggs from each fish were fixed in 1% phosphate-buffered formalin and measured within 120 hours after fixation. The fish were at the same initial stage of ovarian development.

Females were stripped at 12, 16, 20, 24, 36 and 48 hours after injection. Stripped eggs were placed on a petri dish and weighed. The eggs were then fertilized with milt from macerated testes.

All fishes injected with pimozide + 0.05 or 0.10 μg LHRHa per gram body weight ovulated in 16-20 hours. Only 1 of 5 fish injected a lower dose ovulated in 16 hours, and none did of those injected the solution without hormone. Ovulation seldom occurred 24 hours after injection. Egg production and fertilization rate were not significantly different, but hatching rate was higher among fish treated with pimozide + 0.05 μg LHRHa.

Thus, the following protocol is recommended for native catfish: simultaneous injection of 0.05 μg LHRHa and 1 μg pimozide per gram body weight into females, stripping of eggs 16-20 hours later, and dry fertilization of eggs with milt from sacrificed males. Induced spawning of the native catfish and hatchery production of fry can provide seeds for commercial culture and restocking of natural waters.

Source: JD Tan-Fermin and AC Emata. 1993. *Induced spawning by LHRHa and pimozide in the Asian cattish Clarias macrocephalus (Gunther).* Journal of Applied Ichthyology 9: 89-96.

Feeding of fry in nursery

To revive the once widespread culture of *C. macrocephalus* and to ensure a sufficient supply of fry and fingerlings for stocking, SEAFDEC/AQD conducted feeding studies in the nursery. *Clarias macrocephalus* fry were fed live zooplankton (*Artemia* or *Moina macrocopa*) with or without dry diet. Survival was generally high, ranging from 71% to 86%, except among the fish fed the dry diet alone. The specific growth rate over a 14-day rearing period was higher among fish fed *Artemia* plus a dry diet than among those fed either live zooplankton or the dry diet alone. In fact, *C. macrocephalus* larvae can directly take dry diet after yolk resorption. However, continued feeding on the dry diet resulted in poor growth and survival. Moreover, mortality due to cannibalism among these fish increased from 4 to 18%. Cannibalism (1.5%) was much lower among fry fed an artificial diet after feeding on *Artemia* for 7 days.

Source: AC Fermin and Ma EC Bolivar. 1991. *Larval rearing of the Philippine freshwater cattish, Clarias macrocephalus (Gunther), fed live zooplankton artificial diet: A Preliminary Study.* **The Israeli Journal of Aquaculture-Bamidgeh** 43(3): 8744.

Ongoing research on catfish

Several other studies on catfish are now ongoing at AQD. The results obtained in 1992-1993 are given below. These results are unpublished and must not be cited without the authors' permission.

Native catfish under captive conditions do not ovulate without hormone injection and do not spawn spontaneously. The females have to be stripped of the eggs and the males sacrificed to get the milt. Methods to make the native catfish spawn spontaneously are being tested by Luis Garcia. Male and female catfish were given a single intramuscular injection of 0.05 μg LHRHa +1 μg pimozide per gram body weight. Sixteen hours later, they were dipped for two hours in a shallow basin containing 1 μM of either etiocholan-3α-ol-17-one glucuronide, 11β-hydroxyetiocholanolone glucuronide, or their combination. These chemicals may act as pheromones that attract ovulating females. The fish were then returned to a larger tank. No spontaneous release of ovulated eggs nor hydrated milt was observed in any of the pairs up to 30 hours after injection.

The recommended dose combination of LHRHa and PIM was tested by Josefa Tan-Fermin to induce captive catfish to spawn at different times: before (April-May), at the peak (June-September), at the end (October-December) of the breeding season, and during the off-season (January-March). With a combined dose of 0.05 μg LHRHa and 1 μg pimozide per gram catfish, ovulation rate was 100% when fish were injected before and at the peak of the season, but decreased to 80% at the end, and to 60% during the off-season. In contrast, ovulation was never observed in fish given no hormones, LHRHa alone, or pimozide alone.

The optimum milt-to-egg ratio to use in artificial fertilization of the native catfish was determined by Victoria Tambasen-Cheong using the commercial hormone preparation, Ovaprim (a combination of salmon gonadotropin-releasing hormone and domperidone) injected at 2 μl per gram fish. Fertilization and hatching rates were significantly affected by milt volume, but not by the amount of eggs. Fertilization and hatching rates were consistently high when 2.5-10 grams of stripped eggs were inseminated with 25-50 μl milt. Thus the optimum ratio was 25-50 μl milt to 10 grams eggs, or about 4,000-8,000 sperm per egg. Survival of larvae was 60-70% at all milt volumes and egg quantities tested.

Improvement of the hatching efficiency of artificially spawned eggs of native catfish is being sought by Josefa Tan-Fermin. First, the stocking density to use in further experiments was established. In static hatching containers, dissolved ammonia levels were higher when eggs were stocked at 200-800 eggs than at 100 eggs per liter, but pH, nitrite, total hardness, and total alkalinity were not different. All eggs died when incubated at 800 per liter. Then, several ways were tested to remove the adhesive coat of catfish eggs and improve hatching. Fertilized eggs were washed with either, tap water, a salt solution (4 grams NaCl per liter), tannin (0.6 grams per liter), a salt-tannin combination, or a salt solution with 3 or 20 grams urea per liter followed by tannin. In two trials, hatching rates

were 22% in salt solution, 17% in tannin, 23% in salt and tannin, and 10-12% in tap water and other treatments.

The hatchery and nursery techniques for native catfish are being refined by Armando Fermin. Fry (1.6 cm, 30.6 mg) were fed formulated dry diets at 0, 10, 20, 30, or 40% of body weight. After 35 days of feeding, lengths (2.6-2.9 cm) and survival (45-71%) of juveniles were not different among treatments. Starved fry all died within 16 days.

Practical diet for native catfish broodstock are being developed and evaluated by Corazon Santiago. A 21-week feeding trial with wild juveniles showed poor growth and high mortality on four practical diets. A separate feeding trial was then done on hatchery-reared juveniles (8 grams). Control catfish were fed a combination of frozen fish and commercial pellets; four other groups were fed four practical diets with different sources of protein. All four diets contained fish meal, soybean meal, and meat and bone meal at different levels; one diet also contained copra meal, and another diet had ipil-ipil leaf meal. After 36 weeks, all catfish were relatively small (15-23 grams) but some had already matured; fully 50% of those fed the diet with copra meal but only 12% were of those fed the diet with ipil-ipil leaf meal.

The ecological impact of the introduced African catfish is being studied by Alejandro Santiago. First, the predatory habits of the fish were observed in aquaria. Mixed sizes of tilapia, tiger perch (*ayungin*) and gobies (*bulig* and *dulong*) were provided. The African catfish consumed about five tilapia, or five gobies, but one *ayungin* per day. Fish less than 4 cm long were preferentially taken. Culture of the African catfish is now regulated by the Bureau of Fisheries and Aquatic Resources.

... at the African Regional Aquaculture Centre

A paper by AA Adeyemo, GA Oladosu and AO Ayinla of the African Regional Aquaculture Centre (accepted June 1993 for publication in Aquaculture) showed the potential of *Moina dubia* as first feed for the African catfishes *Heterobranchus bidorsalis, Clarias gariepinus* and "Heteroclarias" (hybrid of *H. bidorsalis* male and *C. gariepinus* female).

The use of zooplankton as a first feed source for rearing larvae or fry of hatchery fish has been widely studied. Most studies have shown that the fry grow better when fed with live zooplankton than with dry artificial diets.

Laboratory-cultured *Moina dubia,* mixed zooplankton (harvested from earthen pond), *Artemia* nauplii, and a commercial dry diet (54.2% crude protein) were tested as first feed for the fry of selected African catfish species. Concentrated volumes of the live food were fed daily and the commercial diet was given *ad libitum*

After a 7-day nursery period, the best growth and survival were observed among fry fed *Moina.* Mortality was similar among fry fed the live food diets and somewhat higher among those given the commercial diet.

The better growth of African catfishes fed cultured *Moina* is likely due to the preference of the catfish fry for *Moina* rather than to any nutritional deficiency in the other zooplankton in the diet.

The use of cultured *Moina* is considered a convenient alternative to *Artemia* and dry feeds. *Moina* was cultured as follows: Phytoplankton medium was prepared to contain potassium nitrate (0.132 grams), sodium monophosphate, sodium silicate and ethylenediaminetetraacetic acid (EDTA) (at 66 mg each) in 10 liters of brackish water (salinity 18-22 ppt) from a nearby creek. The medium is exposed to daylight for 3 days to generate a phytoplankton (mostly diatoms) bloom. It was then diluted with filtered freshwater to a salinity of 2 ppm and equally divided into two aquaria, and aerated. The aquaria were then inoculated with 4 individuals of *Moina* collected from earthen ponds.

For more information, write to: Dr. G.A. Oladosu, African Regional Aquaculture Centre, P.M.B. 5122, Port Harcourt, Nigeria.

... at the National Inland Fisheries Institute, Thailand

The hybrid of female *Clarias macrocephalus* and male *C. gariepinus,* was successfully produced by Thai biologists. The hybrids grow more quickly to marketable size than do *C. batrachus* and *C. macrocephalus.*

Studies on the nutrient requirements of the hybrid catfish are undertaken at the Division of Feed Quality Control and Development.

Protein. The hybrid requires approximately 40% protein for optimum growth during the fingerling stage (2-3 grams), a requirement similar to that of the male parent, *C. gariepinus.*

Vitamin requirements for Thai waking catfish

Vitamin Species	Dietary requirement
Vitamin C	
C. batrachus	100 mg/kg[a]
C. macrocephalus	1000 mg/kg[a]
Thiamine	
C. batracus	None within 24 weeks of testing
C. macrocephalus	None within 12 weeks of testing, but 50 mg/kg required after 18 weeks
Riboflavin	
C. batrachus	20 mg/kg[a]
C. macrocephalus	5 mg/kg[c]
Pantothenic acid	
C. batrachus	50 mg/kg[a]
Pyridoxine	
C. batrachus	20 mg/kg[a]
C. macrocephalus	5 mg/kg[c]
Folic acid	
C. batrachus	5 mg/kg[a]
Niacin	
C. batrachus	100 mg/kg[a]

[a]Tested at fixed level vs. vitamin-free diet. [b]Lower levels were not tested. [c]Graded levels tested.

Lipids and essential fatty acids. Recent studies on the proper carbohydrate-to-lipid ratios showed that 5.3-9.8% lipid in combination with starch (to provide estimated digestible energy of 3000 kcal/kg diet) resulted in good growth of the hybrids. The essential fatty acid requirement is probably similar to that of channel catfish. Although lacking exact information, it is wise to mix fish oil and vegetable oil at a 1:1 ratio to provide the essential ω3 and ω6 fatty acids.

Carbohydrates. Diets for the hybrid catfish may contain raw broken rice up to 49% of the diet without causing any harm to the fish. However, growth slowed down when raw broken rice was increased to 54% of the diet The hybrid catfish can be fed cooked broken rice up to 35% of the diet.

Vitamins and minerals. The dietary requirements of the hybrid catfish and deficiency signs for some vitamins are shown below. The mineral requirements for the Thai catfish have not been determined. However, skull fractures in *C. batrachus* are often encountered and are believed to result from dietary calcium deficiency. Supplementation of feeds with bone meal corrects the problem.

Source: ***NIFI Newsletter,*** Vol. 3, No.2, December 1993.

Vitamin deficiency signs in Thai walking catfish

Vitamin	Deficiency signs
Thiamine	None
Riboflavin	Cloudy lens
Pyridoxine	Irritability, equilibrium loss
Pantothenic acid	Clubbed gills, edema, fin erosion
Folic acid	Fading body color, pale gills and liver
Niacin	Spasms, whirling, equilibrium loss
Vitamin C	Scoliosis, darkened skin, fin erosion

A *hito* farmer's success story

Hector Rosario owns a hatchery for African catfish (*Clarias gariepinus*) in Cauayan, Isabela. He also maintains grow-out ponds. Hector says the African catfish is really a carnivore, requiring fish in the diet. But cheaper alternatives have been found. The golden apple snail (golden *kuhol*), which has been pestering rice plants, has become a cheap protein-rich feed for *hito*. Hector says he buys golden *kuhol* at ₱5 per can from the local rice farmers.

Apart from the sale of fry and fingerlings, Hector gets additional income from his *hito* harvest which sells at ₱60 per kg in Cauayan.

In constructing the pond, size, location, sol, water supply, and water depth must be considered. The pond must be 50 m^2 on low flat areas with clay or clay loam soil. There must be good fresh water supply. Water depth must be at least one meter and increased little by little as the catfish grow.

Pond construction

Construct the pond like any other fishpond. Firm up the inner side of the dikes so that the fish will not climb or burrow through them. Construct a fence or board on the dike around the pond to prevent the fish from escaping.

In concrete ponds, cover the bottom with at least six inches of good clay soil to provide a natural habitat for the fish.

Stocking

Broadcast chicken dung and 16-20-0 fertilizer in the pond one week prior to stocking to let plankton grow. Stock late in the afternoon or early in the morning. Hector stocks fry at 10/m^2. To culture and *hito* in one pond, stock four tiapia and five *hito* per square meter. Tilapia must be stocked at least one month ahead of *hito*. The tiapia should be big enough and have well developed scales before the carnivorous *hito* are stocked with them.

Feeding

For two weeks after stocking, the catfish depend on plankton for food. Then, feed the *hito* protein-rich feeds. Give diced golden snail once a day and commercial feeds twice a week. Ground fresh trash fish, worms, insects, slaughterhouse by-products, freshwater shrimps (dried or fresh), fish offal and by-products of canning industries are other alternative feeds. Boiled broken rice (binlid) mixed with vegetables may also be given as feed. A light could also be provided over the pond to attract insects which may be eaten by the fish at night.

Harvest

Harvest the catfish after four months when they weigh more than a kilogram each, or six months at 2 kg each.

African catfish: boon or bane?

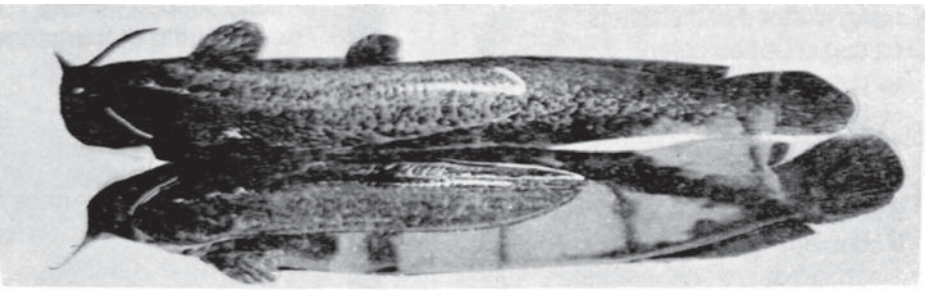
The African catfish *Clarias gariepinus* could be a boon because it could provide the needed animal protein in the diet of many poor families. This fish species can weigh up to 10 kg and grows longer than one meter. Its flesh is soft and tastes as good, if not better, than the native *C. macrocephalus.* For fish growers and vendors, this can mean big profit.

The African catfish could be a bane because it voraciously eats anything that fits its wide mouth. A 13 kg catfish can eat a lot of other fish. A fish grower in Candaba, Pampanga said that ail the other fish species he was raising in the same pond were devoured by the African catfish. Polyculture of the African catfish with other fish would likely not succeed. Fish growers advise others not to wade in ponds where there are many big African catfish, especially if they are in shorts. "Dangerous," they said.

BFAR experts have been ordered to study the behavior of the African catfish to see how it can be raised without adverse effects. The bigger threat comes from African catfish that escape into natural waters. Just as introduced carnivorous fishes (gobies) drove local carps in Lanao Lake to extinction, so would the African catfish threaten the native fish populations in Philippine rivers and lakes. Extinction is forever; extinct fishes mean "no catch."

It could not be established when the African catfish was introduced in the country, and who introduced it. Some accounts said these were introduced at the same time as the Thai *C. batrachus.*

Source: *Philippine Daily Inquirer,* April 11, 1993.



Male (upper) and female *Clarias gariepinus* measure 0.7 m after one year.

Video on African catfish

A video on ***Farming of the African Catfish Clarias gariepinus in the Philippines*** is available at SEAFDEC/AQD. This documents the survey of the ecological impact of introduced exotic species. A joint production of SEAFDEC/AQD and the Bureau of Fisheries and Aquatic Resources. 1993.14 min. VHS.

Catfish is gourmet, too

In the United States, catfish has gradually achieved gourmet status. It was featured in an article by writer-chef Jacques Pepin in the March 1986 issue of *Gourmet,* one of America's fashionable food magazines read by those who have, or wish to have, sophisticated and discriminating palates.

Most popular in the US is the channel catfish. The fish has only one large skeletal bone. Its meat is high in protein and low in fat. It lends itself well to a great variety of preparations — fried, barbecued, smoked, served as *hors d'oeuvres,* soups, *sushi,* and so on. For instance, catfish fried with a cornmeal coating makes for very good eating indeed.

Source: **Infofish Marketing Digest** No. 4/86.

From the Mississippi Dept. of Agriculture and Commerce are these two recipes:

Catfish Gumbo

1/2 kg skinned catfish fillets
1/2 cup chopped celery
1/2 cup chopped green pepper
1/2 cup chopped onion
1 clove garlic, finely chopped
1/4 cup melted fat or oil
2 beef bouillon cubes
2 cups boiling water
1 can tomatoes, 250 grams
5 pcs okra, sliced
2 tsp salt
1/4 tsp pepper
1/4 tsp thyme
1 whole bay leaf
Dash liquid hot pepper sauce
1 1/2 cups hot cooked rice

Cut into 2-cm pieces. Cook celery, green pepper, onion, and garlic in fat until tender. Dissolve bouillon cubes in water. Add bouillon, tomatoes, okra and seasonings. Cover and simmer for 30 minutes. Add fish. Cover and simmer for 15 minutes longer or until fish flakes easily when tested with a fork. Remove bay leaf. Place 1/4 cup rice in each of 6 soup bowls. Fill with gumbo. Serves 6.

Continental Catfish

6 skinned, pan-dressed catfish
1 tsp salt
Dash pepper
1 cup chopped parsley
1/4 cup butter or margarine, softened
1 egg, beaten
1/4 cup milk
1 tsp salt
3/4 cup dry bread crumbs
1/2 cup grated Swiss cheese
3 tbsp melted fat or oil

Clean, wash, and dry fish. Sprinkle inside and out with salt and pepper. Add parsley to butter and mix thoroughly. Spread inside of each fish with approximately 1 tbsp parsley butter. Combine egg, milk, and

salt. Combine crumbs and cheese. Dip fish in egg mixture and roll in crumb mixture. Place on a well-greased cookie sheet 39 × 30 cm. Sprinkle remaining crumb mixture over top of fish. Drizzle with fat. Bake in an extremely hot oven, 260°C for 15 to 20 minutes or until fish flakes easily when tested with a fork. Serves 6.

in rural Philippines, a common way of cooking *hito* is with pepper, vinegar, and coconut milk. In its compilation of selected recipes, Fish Cookery, the Philippines' Bureau of Fisheries and Aquatic Resources has the following:

Adobong Hito

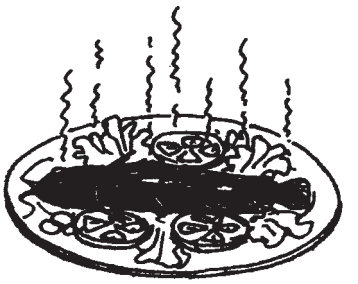
1 kg *hito*
2 cloves garlic
2 cups water
1/2 cup vinegar
1/4 cup soysauce
1 tsp pepper
3 onions, sliced
Salt to taste
Cooking oil

Wash *hito* thoroughly and boil in a saucepan with water, vinegar, pepper, soysauce and salt to taste. Saute crushed garlic in pan. Add *hito* and onions and saute until slightly brown. Four to six servings.

Hito with Cassava Tops

2 pc *hito,* cut into serving pieces
1 pc ginger, chopped
2 cups cassava tops
11/2 cups rice washing
Red pepper for garnishing
Sat to taste

Clean and slice fish. Place in a saucepan fish, rice washing, ginger, cassava tops and cook until done. Season with salt to taste. Four servings.



SUCCESS STORY ... FROM PAGE 16

To harvest, partially or totally drain the pond. Use seine and scoop net to capture the fish.

Farmers who wish to raise African catfish can buy *hito* fry from Hector in Cauayan, Isabela at P2 each. To help interested *hito* raisers, Hector is planning to organize a cooperative. Interested farmer-members could get fry at only half the price and pay in full after harvest. Hector is confident that his plans would push through.

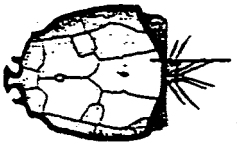
Catfish farming, anyone?

Source: MR Dilay, *A prolific fish called hito.* **Aggie Trends**. Dept. of Agriculture, Diliman, Q.C. Sept. 1993.

Aquaculture clinic

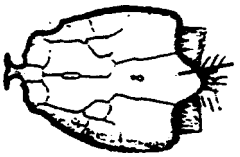
How do you distinguish the native catfish from the Thai catfish? How about the African catfish?

The native (*Clarias macrocephalus*) and Thai (*Clarias batrachus*) catfish are similar in size and color. The only distinguishing feature is the shape of the occipital process at the back of the head. The occipital process is blunt in *C. macrocephalus* and pointed in *C. batrachus*.



blunt occipital process

Native catfish
Clarias macrocephalus



pointed occipital process

Thai catfish
Clarias batrachus

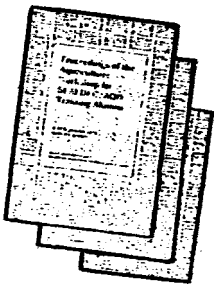
Both *C. macrocephalus* and *C. batrachus* grow to a maximum of 400-500 grams. The African catfish *Clarias gariepinus* (or *lazera*) grow much larger, up to 13 kg in body weight.

When is the spawning season of catfish?

The natural spawning season of catfish coincides with the rainy season. Catfish mature within the first year of life. Mature eggs are carried by the female catfish throughout the year but are released only during the natural breeding period. In captivity, catfish normally do not spawn spontaneously. Gravid females can be induced to spawn by injection of agents such as pituitary extracts, human chorionic gonadotropin, luteinizing hormone-releasing hormone analogue, alone or in combination with the dopamine antagonists pimozide or domperidone.

For more information, contact Ms. Josefa Tan-Fermin, SEAFDEC Aquaculture Department, P.O. Box 256, Iloilo City 5000, Philippines. - *Ed*

OFF THE PRESS



Proceedings of the Aquaculture Workshop for SEAFDEC/AQD Training Alumni
Edited by: CT Villegas, MT Castaños, RB Lacierda

For more information, write: Training and Information Division, SEAFDEC/AQD, P.O. Box 256, Iloilo City 5000, Philippines.

Addendum to Policing Fisheries

July-October 1993 issue of *Aqua Farm News*

Illegal fish pens in Laguna de Bay

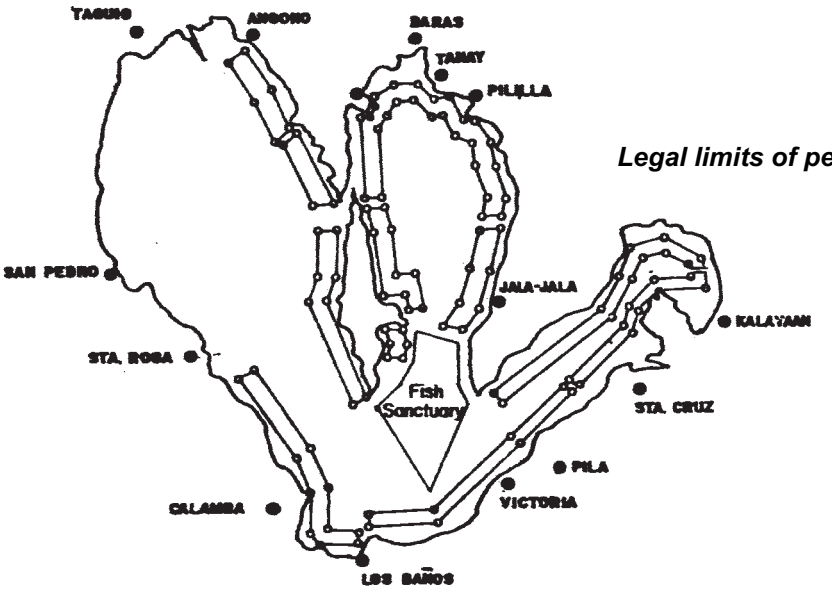
A study in contrast are these two figures showing what is legal and what goes beyond it. The reader is free to imagine how much more pens are proliferating there at present.

The SEAFDEC Aquaculture Department is set to publish a monograph on the lake next year.

Import of live shrimps

To prevent the introduction and spread of diseases which may endanger the shrimp industry, it is unlawful for any person, association, cooperative, partnership, or corporation to import live shrimp and prawn of all stages. However, special permits may be granted for scientific or educational purposes.

- ***Fisheries Administrative Order 189,1993***



Legal limits of pens

Fish pens in 1984

Illustration from MCM Beveridge. 1984. *Cage and pen fish farming, carrying capacity models, and environmental impact.* FAO Fisheries Technical Paper 255.

SEAFDEC/AQD NEWS

ADSEA III in July 1994

Towards sustainable aquaculture

Aquaculture development in Southeast Asia will be discussed in a seminar-workshop at Tigbauan, Iloilo in 26-28 July 1994 (ADSEA III). Jointly sponsored by the SEAFDEC Aquaculture Department and the Government of Japan, ADSEA III follows those held in 1987 and 1991. The theme will be "Sustainable Aquaculture Development"

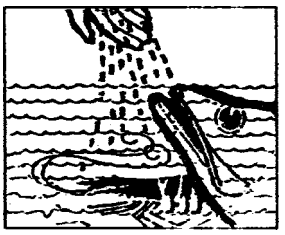
Invited as participants to ADSEA III are aquaculture and fisheries scientists from the Philippines, representatives of SEAFDEC Member Countries (Japan, Singapore, Malaysia, Thailand, and the Philippines) and from Vietnam and Brunei Darussalam, and representatives from international organizations.

ADSEA assesses existing aquaculture technology for important fishes, shrimps, molluscs and seaweeds in Southeast Asia, particularly technologies developed from 1992 to 1994 by SEAFDEC/AQD in Iloilo. ADSEA HI will examine the contribution of these technologies to sustainable development in the region and set priority areas for research and collaboration among SEAFDEC Member Countries.

The seminar-workshop will feature invited speakers who will review the present state of aquaculture development. Research directions in breeding, hatchery and nursery, nutrition and feed development, diseases, farming systems, and socioeconomic and environmental issues will be discussed. These will be the basis for SEAFDEC/ AQD's research plan for 1995-1997.

For more information, contact ADSEA III Secretariat at telephone (63-2) 9245511 to 13, (63-33) 271009 and fax (63-2) 9245511 local 23, (63-33) 271008.

National Seminar-Workshop on Fish Nutrition and Feeds



Advance registration is ongoing for the *National Seminar-Workshop on Fish Nutrition and Feeds* to be held 1-2 June 1994. Please contact: Ms. Myrna N. Bautista, SEAFDEC/AQD.

The seminar-workshop will discuss feeds for small-scale aquaculture. There will be papers on nutritional requirements, indigenous feed resources, feed formulation and evaluation, equipment, and feeding techniques.

Notes from the Editor

Mail from the readers

Ms. Giselle Barreto of the Institute of Social Order at the Ateneo Campus in Quezon City wrote: "1 was impressed by the marketing information, trends and technology information given by your publication," referring to. AFN issue on lapu-lapu or grouper (Vol. X, No. 3, May-June 1992).

The lapu-lapu issue has also been cited by Ichthos (No. 38, June 1993), a newsletter of the Society of Friends of the JBL Smith Institute of Technology (South Africa).

Deputy Executive Director Roberto F. Villarroel of the Cooperative Development Authority, a unit of the Office of the (Philippine) President, acknowledged that the AFN issues beef up the library collection for the general public. So did Ms. B. van Moffaert of the University of Ghent - Laboratory of Aquaculture and the Artemia Reference Center: Evangeline Paza of the Mindanao Polytechnic State College - Panaon College of Fisheries; and Sotelo Aban of Pangasinan.

Laura Kadlecik, a Peace Corps volunteer in Catanduanes wants to know about ferrocement buoys for mangrove seedlings. Dr. Barry Goldman of the Marine Resources Management Division in Yap State (Micronesia) wishes to know the researchers involved in the seafarming project (AFN Vol. X, No. 5, Sept-Oct l992 and SEAFDEC Newsletter Vol. 15, No. 4, Dec 1992). Some others needed the original articles excerpted in AFN.

A Guest Editor for AFN

The credit for conceptualizing and editing this issue on catfish culture goes to Ms. Julia C. Lagoc. Our guest editor was previously head of SEAFDEC/AQD's Audiovisual-Print Section that is charged with the production of Department newsletters, manuals, video programs, among others. She also edited AFN from 1988 to 1990. She left the Department for a while to travel to the USA where her daughters (and a grandchild) now reside.

Said Julie on AFN: "AFN services the poor fishfarmers who lack access to information. I continue to hope that this great aquaculture facility (SEAFDEC/AQD) will make a difference in the lives of the marginal fisherfolk, that sustainable and equitable benefits from R&D efforts are not just a dream. Otherwise, the mission to respond to the global food crisis is just so much hyperbole."

-MT Castaños

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In citing Information from AFN, please cite the institutional source which is not necessarily SEAFDEC/AQD. Mention of trade names in this publication is not an endorsement.

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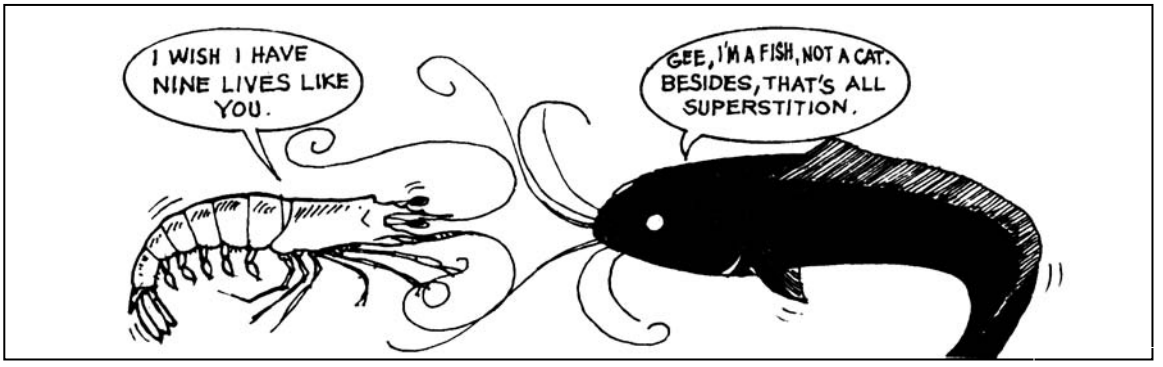
Nine lives



by E. Ledesma

Better life through aquaculture