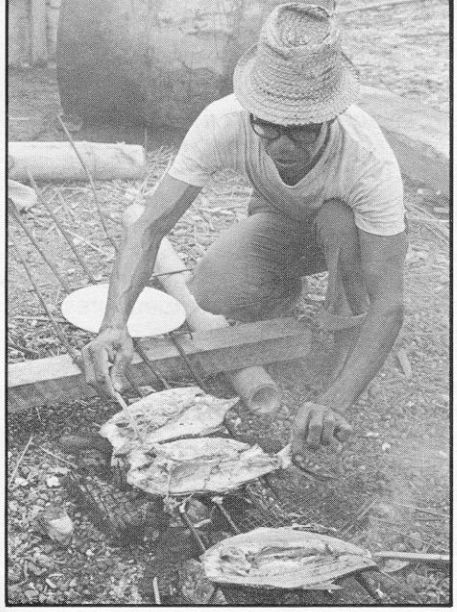
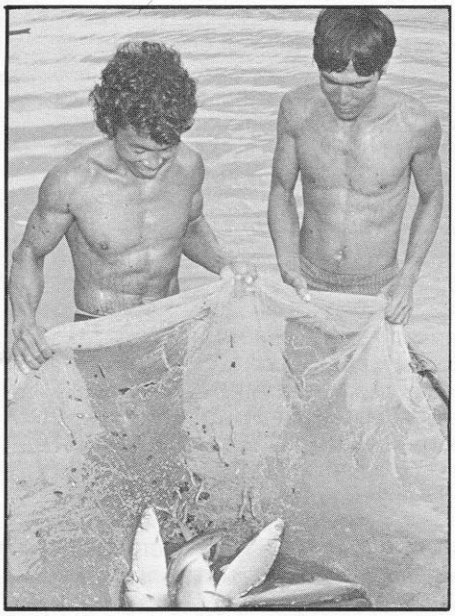
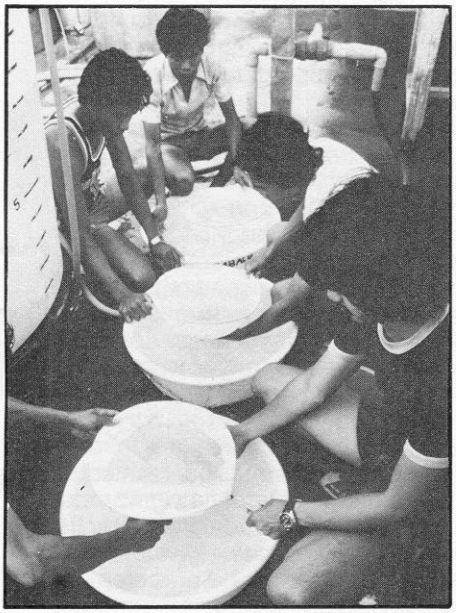






Facing page: Milkfish, a bounty of protein. Above, top to bottom: Milkfish are the preferred fish of Filipino consumers. Harvesting the crop in experimental ponds. At SEAFDEC, milkfish eggs are washed in preparation for fertilization.

A SILVER-BLUE REVOLUTION

MILKFISH FARMING IN ASIA

MICHELLE HIBLER

As the sun sets over the Gulf of Panay on the western edge of the Philippine archipelago, a dozen small boats set out from shore. Kerosene lamps bob over their decks, the better to attract ever-scarcer fish to the waiting nets.

The waters off Panay Island are among the richest milkfish grounds in the Philippines. Yet the most promising fishing areas may well be a hundred metres away, on shore. These are the headquarters of the Aquaculture Department of the Southeast Asian Fisheries Development Centre (SEAFDEC), at Tigbauan, Iloilo Province.

Milkfish (*Chanos chanos*), the only surviving member of the Chanidae family, were first identified in the Red Sea by Forskal in 1775. And although they are widely distributed in tropical waters from Africa to the Americas, it is only in Southeast Asia — mainly Taiwan, Indonesia, and the Philippines — that the milkfish is extensively farmed.

Known as *bangos, bangus,* or *sabalo* in the Philippines, milkfish are the preferred fish of Filipinos and the main aquaculture species. The culture of the silvery blue fish in brackish water ponds was in fact noted by Magellan when he landed on the shores of Cebu some 450 years ago. The reasons, as explained in the 1932 study published in the *Philippines Journal of Science* are: "...the remarkable adaptability of the *bangos* and its acceptable quality for the ember and pot....Rapid of growth, vegetarian, and absolutely non-cannibalistic in habit, prolific by nature, and palatable in flesh, the *bangos* as a pond and food fish is without question one of the best. The availability of the fry or tiny young in numerous quantities during seasons of the year is a very important factor in its favour."

That may well have been true in 1932 but, in the 50 years since, those "numerous quantities" of fry have not been sufficient to meet demand. An estimated 1.3 billion fry are needed annually to stock the close to 160 000 hectares of ponds devoted to milkfish culture in the Philippines alone. Fry collection, using age-old techniques that are highly destructive of other species of aquatic life, yields only 500 million.

As the early researchers noted, although the milkfish is prolific in the wild: "It is a well established fact that *bangos* do not reach sexual maturity in the fishponds, no matter how large the ponds may be nor how long the fish are kept in captivity." And that became the major stumbling block to the expansion of milkfish cultivation throughout Asia.

In fact, little new information on the milkfish had been obtained since the early 1930s. By 1975, all that was known was the geographical distribution of spawning adults and fry, some indication on the location of spawning grounds, and limited data on the development of suspected milkfish eggs and larvae.

Thus, when SEAFDEC launched a project to develop a technology to improve the production of milkfish, mass scale seed production was planned. But first, a number of basic questions needed to be answered: How and where do you catch a milkfish breeder alive? Having done so, how do you keep it alive? How do you differentiate between males and females, since there are no obvious external characteristics?

SEAFDEC's seed production team started out by capturing wild spawners, but mortality was high. Milkfish are in fact so excitable that capture and handling causes stress that often results in death, sometimes within minutes. A technique for handling and transporting wild *sabalo* had to be developed. By towing the cages to shore and transferring the fish to individual plastic bags carried on a hammock, and carefully releasing the fish in tanks with controlled salinity, a good survival rate was achieved.

The first experiments to induce milkfish to spawn in 1976 met with partial success. Females injected with purified salmon gonadotropin ovulated, but the eggs could not be fertilized since none of the males responded to treatment. In April 1977, however, newspaper headlines throughout the Philippines proclaimed "Bangus is born", "Breakthrough in milkfish culture", and even "Bangus without sex". Indeed, spawning had been induced by injecting hormones, namely acetone-dried powdered salmon pituitary gland and human chorionic gonadotropin. The eggs were fertilized with sperm from induced males, incubated, and hatched.

Because of the expectations it created in Filipino fish farmers, SEAFDEC's

researchers were somewhat embarrassed by the fanfare — including a presidential citation — that accompanied this "world first" induced breeding of milkfish. Dr Jesus Juario, project leader, cautions that the process remains to be refined and standardized before milkfish farmers reap the benefits.

Standardization of the techniques requires a more abundant and reliable supply of spawners than can be caught by chance in the open sea. Since 1975, therefore, pond-grown juveniles were stocked at the aquaculture department's marine station at Igang, on Guimaras Island, and were being domesticated and raised as broodstock. Spent wild *sabalos* — adult fish who had already spawned — were also kept in cages in the sheltered cove to see if they could be induced to spawn again.

Every week, fish in the induced maturation cages were injected with hormone pellets to stimulate gonadal maturation, but to no avail. Fish in other cages were part of a control group, to see if they would mature naturally. They didn't. Every month, the cage netting of both was changed to prevent fouling and fish were removed for examination.

The researchers began to suspect that this handling was preventing maturation. As Dr Juario explains, even the fish raised from the eggs fertilized in 1977 and now tame enough to eat out of the researchers' hands return to their wild and nervous habits if one of their numbers is handled. They therefore decided to leave some of the fish alone. Six months later, in August 1980, all the fish in the "neglected" cage had matured and the researchers recovered some 1400 eggs outside the cage.

The advantages of spontaneous breeding are obvious: it requires only floating cages that could be established almost anywhere, reducing the need for recirculating and aerated tanks and costly transport of fry. Recovery of the floating eggs is still a problem, however. Various cages have been designed at Tigbauan, but none so far is satisfactory to both the fish and the researchers.

Breeding was only one thrust of the research. Ecological surveys were carried out to locate milkfish spawning grounds. It was known that fry appear along the coast, remain for a few days, and disappear out to sea only to return as spawning adults. Local fishermen suggested to the researchers that Batbatan Island, off the west coast of Panay Island, was a major spawning area. They were right, and, for the first time since 1926, a number of eggs were collected.

The researchers concluded from their surveys that milkfish spawn during the four days before and after a full moon. The eggs hatch in the surface layers of water, the larvae float down and are driven toward shore, carried by waves and currents.

Fishermen also told the researchers that they never captured adult milkfish — illegal in any case — until "the grass in the villages becomes brown and brittle." SEAFDEC's researchers charted the fish's movements: up the coast at a distance of one to two kilometres from shore during the dry season from April to August, and back again in September. This correlated with increasing, then decreasing, water temperatures, and suggested that milkfish do not spawn in waters colder than 27°C or warmer than 30.6°C.

These studies will enable the researchers to identify the ecological conditions best suited to the frys' survival and growth and for natural spawning of adults.

Techniques of milkfish culture have changed little since Magellan's arrival in 1521. Packed earth forms a dike around a grid of different-sized enclosures — nursery ponds, transition ponds, and growing out ponds. Along the road to the Leganes station, small shallow ponds line the road. During the dry season they are used for evaporating seawater to produce salt. In other seasons, they grow fish. The average yield is 600 kg per hectare annually, while yields of 2000 kg are reported in Taiwan.

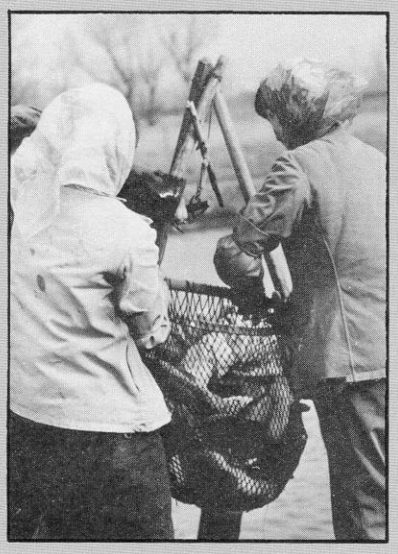
At the station, efficient ways of increasing production are being tested. Pond engineering, fertilization, feed production and predator control are all studied. For example, feed trials have indicated that *lablab* — a mixture of algae — is an important natural food for milkfish of all ages. To date, no satisfactory formulated feed has been found. Pond designs incorporating special ponds for growing *lablab* have now been developed. Polyculture experiments have shown that milkfish and prawns can be grown together.

The studies are continuing, building on the successes to date and making further inroads into the mysteries surrounding the life of the milkfish. One of the main problems left to be solved is fry mortality. For every 1000 fry stocked in ponds, only 378 fish are harvested. According to Dr Juario, the first 3-4 weeks are crucial and the low survival rate is the same for fry collected from the wild or bred from spawners — anywhere from 13 to 70 percent.

Boosted by their successes to date, the researchers — many of whom have been able to pursue their training through the IDRC-funded project — are confident they will succeed.

Dr Juario points out that some 1.5 million hectares of tidal flats, swamps, lagoons, and other bodies of water lie idle in the Philippines — waters that could produce both food and employment. The project may be instrumental in fostering the development of these areas.

And despite the caution expressed by the SEAFDEC team — who have become known as the Sabalo Sex Team — some benefits are already being reaped by small farmers in the form of increased credit and financing for aquaculture activities. A silver-blue revolution may be underway. □



THE WAY TO HIGHER YIELDS

The People's Republic of China has an estimated 10 million hectares of water being "farmed" to some extent. Thirteen of these hectares are located on the outskirts of Beijing, at the Beijing Aquatic Products Supply and Marketing Corporation, one of 10 state-owned fish farms in the area.

Using induced breeding techniques, the farm produces most of the seed needed to stock its ponds. Eight species of fish are grown in a polyculture system. The fingerlings are released in early March, although the waters are still cold, and are usually harvested in the fall. All the ponds are mechanically oxygenated and a system of small canals carries supplementary feeds — grass clippings, bean mash, wheat and rice bran, and corn — to the ponds.

Disease is not a problem, says Mr Yao Shizhi, the farm's director, because close attention is paid to water quality. Following China's policy of prevention first, disease control medications are also added to the ponds shortly after stocking.

Despite the high yields obtained for a cold region, Mr Yao is not satisfied. "We have gained much experience," he says, "but we must make more improvements." These improvements are brought about by experimentation in two of the farm's ponds. By stocking a greater number of fish of different sizes — ranging from 250 g to 1.5 kg — they have been able to obtain net yields of 20 000 kg/hectare. "There are three ways for us to improve our yields," says Yao, "by educating people, by inviting specialists to come and make suggestions, and by improving our own production techniques."