LECTURE NOTE

ON

PRODUCTION OF OTHER MARINE PRODUCTS (3 UNITS)

FIS 503

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FIS 503: Production of other marine products (2units)

Culture of shrimps, oysters, crabs, crayfish, lobsters, cockles, periwinkles, marine gastropods, frogs, edible sea weeds and free water plants

Culture of Shrimps

Shrimp is the most important commodity, by value, in the international seafood trade. The shrimp industry has grown exponentially in the last decades, and growth is expected to continue for years to come.

A new and better technology to culture shrimps is being used by many enterprising shrimp farmers nowadays known as **Green water technology,** a technique that cultures shrimps in water that is abundant in phytoplankton i.e. Chlorella, turning the water green hence, its name.

In this system, tilapia is also grown in the reservoir or net cages/ pens in the ponds. The green water produced from tilapia helps control the growth of luminous bacteria that is bad for the growth of the shrimps.

The green water technology consists of: pond preparation, water culture/fertilization, stocking and stock sampling, feeding management, water management and aeration, and harvest and post-harvest handling.

Pond preparation

To prepare the pond, it should be dried and drained of water for three weeks until the soil at the bottom is cracked. The muck or the black soil at the bottom of the pond should be scraped off. Then the ponds are flooded with water and dried for another week. Hydrated lime at a rate of 2 tons per hectare is applied before the final flushing and sun drying.

When the pond is clean and dry, double hapa nets (10×10x1.5 meters) should be installed at the center of the pond. Bamboo catwalks from the dikes to the pens should be installed to facilitate easy feeding and monitoring of fish.

Water culture/fertilization

After installing the pens, the ponds should be filled with seawater to a maximum depth of 1.0-1.2 meters and the gates should be sealed. The water depth should be maintained by installing a depth gauge. To make sure that the water is free from predators and other possible competitors, teaseed powder (20 ppm) should be applied. Fine mesh screens should be installed at each outlet of the flume to prevent predators from entering the pond during pumping.

Stocking and stock sampling

To check the growth and condition of the shrimps, the stock should be sampled after 30 days from culture and every 10 days thereafter. For tilapia, stock sampling should be done monthly.

Feeding management

For shrimps, they should be fed right after stocking. Shrimp feeds are broadcasted around the pond with a portion of the feeding ration left in the feeding trays. Four trays measuring 0.25 square meter should be installed to monitor the amount of feeds consumed everyday. During the first 30 days, blind feeding is practiced. About 200 grams of feed per 10,000 postlarvae is given. One to three hours after feeding, the trays are lifted and the amount of feed consumed is estimated. From 40 days of culture, the shrimps are fed five times a day, i.e., 6:00 AM. 10:00 A.M., 2:00 P.M., 5:00 P.M. and 10:00 P.M. at 20%, 10%, 10%, 35%, and 25%, respectively of the total feeding ration.

Tilapia are fed 5% of the body weight. They are fed twice a day at 8:00AM and 2:00 PM and the ration is adjusted based on the average body weight of the fish every sampling period.

Water management and aeration

After 30 days of culture, 10-20% of the water in the pond is drained and replaced with water from the reservoir ponds. It should be noted that the water from the reservoir ponds should be allowed to stay for at least 4-5 days before they are used to replenish the water in the shrimp rearing ponds.

The ideal amount of dissolved oxygen is maintained by using six paddlewheel aerators. In the first 60 days, only four aerators are alternately operated for 24 hours. Another aerator is installed in each tilapia pen to increase the circulation of water and phytoplankton in and out of the pens.

Harvest and Postharvest handling

Shrimps are harvested when they weigh at least 30 grams. Harvesting is done by draining the water and collecting the shrimps using a harvest net installed at the pond gate. The collected shrimps are placed in water with crushed ice to maintain their quality. The shrimps are then sorted according to size and placed in boxes with crushed ice to be shipped to shrimp processing plants where they are packed for export purposes.

Source: “Green Water Technology” 2003 by Mr. Valeriano L. Corre, Jr. of the University of the Philippines in the Visayas, Miag-ao, Ilo-ilo, photo from shrimpfarming.tripod.com

Oyster Culture Techniques

The four most common oyster culture techniques are:

- Beach culture
- Bag culture
- Suspended culture
- Dike culture

Beach culture is the simplest and most common method of growing oysters in the Pacific Northwest. Generally, oyster spat is purchased from a hatchery and spread onto a farms beach in the intertidal zone. Spat can be purchased at different levels of development, with the more mature product costing the most. Once spread onto the beach, spat are vulnerable to natural predators like crabs, starfish, birds, and oyster drill snails as their shells are still very thin. To overcome this, some farms will cover the spat with netting or put them into fenced pens. Beach culture produces the slowest growing oysters, as they are subject to wind, wave, and tidal abuse that tend to wear away their fragile new shells. They end up being the thickest shelled oysters, and usually the easiest to open, because of this slow growth. They tend to be grayish in appearance, as the sun bleaches the color out of their shells over time.

Bag culture is also common. Large mesh bags containing oyster spat are attached to lines that are in turn staked to the beach in the intertidal zone. The oysters are considerably more protected than those that are beach cultured, as the mesh bags keep many predators at bay and will also protect the oysters from some of the weather abuse that slows their growth. In addition, it will block a significant amount of the sunlight that bleaches the color out of their shells. Predictably, the shells of bag cultured oysters are thinner than those of beach cultured oysters, and their appearance is more liable to include some combination of blues, purples, tans, browns, and whites, depending on the mineral content of the water in which they are grown. These oysters will mature more quickly than those that are beach grown, however, this method is more labor intensive. In order to produce oysters that get the increased growth rate and that are well shaped, the bags must be thinned out regularly as the product grows in size, and they must be flipped over numerous times to keep any prevailing winds or currents from piling the oysters into one end. Oysters left piled together will grow much more slowly, and worse, they will grow poorly shaped… long thin (snaky) shells, shells without much cup, or shells with their hinges wrapped around underneath them.

Many farms now utilize a combination of these two methods, starting spat in bags and then transferring them to the beach as they get a little bigger and heavier. By allowing oyster spat to start in bags on the beach, a farm can increase their survival rate significantly. By allowing them to finish directly on the beach, they allow the oysters time to develop harder shells and stronger abductor mussels, while saving themselves the time and expense of dealing with the bags as the oysters start to increase in size.

Suspended culture involves hanging nets or trays containing spat from some means of flotation system. Rafts, buoys, and long lines supported by a series of buoys are common means of achieving this. Oysters grown this way are not in the intertidal zone at all, but are in the water all the time, rising and falling with the tide. They are well protected from most predators, and get no exposure to the bleaching effects of the sun that would otherwise dull their appearance. Suspended culture oysters grow the most quickly, as they are feeding 24 hours per day, seven days per week. This is a real plus for an oyster farm, since they are turning their investment in spat back into cash very quickly, but it involves a compromise. This growing method produces shells that are thinner than either of the other techniques mentioned, and one must be careful not to chip their fragile edges. In addition, it produces oysters that have weak abductor muscles. Oysters use their abductor muscles to keep their shells tightly closed when they are out of the water. Without the daily exercise that Mother Nature provides intertidal oysters, the muscles of suspended culture oysters are comparatively weak. They will tend to open up and dry out more quickly than oysters cultured intertidally, but most farms growing suspended culture oysters attempt to overcome this by packing their oysters in boxes cup side down. By doing this, they minimize water loss when the muscles do relax, as the liquid in the deep bottom cup is trapped. Farmers utilizing this technique must, like those using the bag technique, keep their trays or nets thinned out, as high densities create poorly shaped oysters.

Dike culture involves building low rock or cement walls around pools to keep the water in when the tide goes out. Diking portions of the intertidal zone ensures that the oysters are always covered by water. This allows them to feed continuously while protecting them from freezing in the winter and from getting too hot in the summer. Dikes are used primarily in the culture of Olympia oysters.

Crab culture

Crab farming as a practice is not common in Nigeria. In the early seventies when some fishpond operators in Bicol, Visayas, and Southern Tagalog in Philippines started to culture crab as a subsidiary crop in milk fish or bangus ponds.

The crab species Scylla serrata is the biggest and most important member of the family of edible crabs in the Philippines.

Mud crab, or alimango, is considered a delicacy and has become a popular fare in seafood restaurants. It is sought for its very tasty aligue or ripe eggs in the ovary.

Crabs abound in estuaries, mangroves, swamps and tidal waters, living both as a scavenger and a cannibal.

Breeding and Spawning

The mating period of crabs is usually long. When mating, the female is carried by the male, clasping her with three pairs of walking legs. In this condition, it is very easy to catch them. After five days, the female is finally released by the male. Mating usually occurs for four months, during the period May to September. Prior to that, in April, the females develops eggs or aligue.

Crabs spawn in the sea. The newly hatched larvae called zoea are free-swimming. They are carried by the tide to the coast where they migrate to live-in estuaries, swamps and mangroves. Fertility is very high among females. As much as a million eggs can be laid but mortality is also high because of inclement climatic conditions.

Molting

This is an indispensable stage in the life cycle of crabs. During molting, they shed their covering or carapace. This happens when there is an abrupt increases in the size of their body. After shedding the old carapace, the crab is left with a very soft covering. It becomes an easy prey to other animals and to survive, the crab buries itself under the mud until the soft shell hardens.

Culture and Cultivation Methods

Small crabs or crab seeds are caught by fishermen in seashores, swamps and other natural habitats. They are gathered and sold to fishponds operators.

Crabs are raised in brackish water fishponds. Crab and can be raised simultaneously. It is, however, not advisable to culture crabs together with prawns, because when prawns undergo molting, crabs eat them.

Choosing the Crab Farm

Choosing a site for crab farming is not difficult. First, there should be adequate supply of estuarine water because good and stable salinity is conducive to growth. Smaller ponds are advisable since they are easier to manage. Make sure the soil is clay or clay loam. This kind of soil is capable of retaining water. If possible, the site should be free from floods. The depth of water is also important. Advisable depth is one meter to prevent exposure of cultured crabs and stop them from boring holes through the dikes. For easy harvesting, the site should have good drainage. This also facilities the practice of pond freshening whereby the water is cleansed by letting in fresh seawater. Available of crab seeds in the area is also important. This ensures a steady number of young crabs for rearing and the continued operation of your farm.

Managing the Crab Farm

For crab farming, the ponds are prepared just like any bangus fishpond but the side of the dikes should be very firm to discourage the crabs from burrowing through. Place banatan or bamboo screen along main dikes to prevent escape of crabs. About 2,000 to 4,000 crab seeds, 2 to 5 cm in length and size, would be needed initially. Stock them directly in the rearing ponds. Feeding is not a problem since young crabs feed on algae and decaying organic matter. As they grow, crabs become carnivorous. Supplement their feed with trash fish and leftover food. Their rate of growth is rather slow. It takes five to six months for crabs to grow into marketable sizes.

Application of fertilizer is helpful. This enhanced the growth of natural food like moss in the ponds.

Harvesting

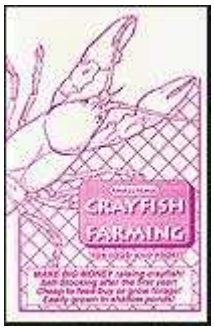
This is done with different kinds of trap like the bamboo cage, lift net, scissors net, fish corrals and gill nets. Crabs are ready for the harvest and marketing when the piece or two reaches up to a kilo. They are sold alive and can stay out of the water even for a week. They should, however, be kept in damp containers and periodic moistening is important. Feed them with trash fish and other kitchen refuse.

Handling

Adult crabs in captivity are tied with dried nipa strings. Both pincers are tied close to the abdominal cavity to prevent crawling. When transported, proper handling is important. Place them in baskets or tiklis to avoid getting trampled or crushed.

Crayfish culture

Freshwater crayfish are highly regarded as a delicacy as they are very similar to shrimp or lobster in taste and texture...high protein and low-fat.



The crayfish is a very promising aquaculture species. Fish farmers have become major players in this bottomless market in only a couple of years. Small scale family run operations are harvesting 'short lobsters' in less than a year, and the start-up costs are low. Included in the book are photos, food and feeding regimens needed to raise crayfish to giant size, well managed pond factors, hatching and juvenile production, stocking methods, sources of supply, sale & processing tips, and marketing recommendations. This book is easy to read, well organized, and packed with hard to find information. Targets the small farmer or homesteader.

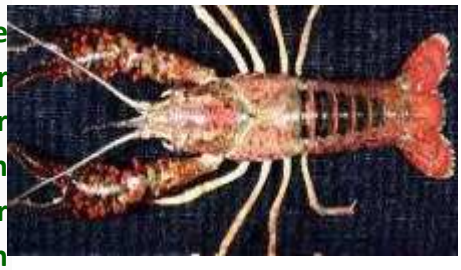
Look at the huge crawfish to the right. That's a 5 gal. bucket they're in! How did they get so big? The answer is simple...ideal growing conditions. These are a common variety of crayfish found all over the U.S. except the South where summers are too hot for them. Given the right conditions, they can attain this size (and larger!) in a single season. After the first year, crayfish are 'self-stocking',

meaning they propagate naturally if allowed to. It is more efficient to raise the young in tanks (giving a 98% survival rate), but that requires a little more effort. Careful harvesting can produce ever-larger specimens if the largest crayfish are returned to the pond to reproduce.
The best production is obtained with a combination of natural and processed feeds. Natural sources include hay, grass and other vegetation. Processed feeds include range pellets, dog food, sinking fish food, and of course crayfish feed. Stock can be obtained from existing crayfish farms as juveniles or adults, or one can capture a local variety of crawdad quite easily.

(left) This is a somewhat rare variety of crayfish (Pacifasticus), found in Pacific Northwest streams and lakes. It grows much larger than other varieties in the U.S.; unfortunately it takes 18 months or so to mature and breed. This makes it not too well suited for culture..except in that region.

Sometimes called a 'short lobster, this variety can be raised indoors in tanks. These can be relatively easy and inexpensive to establish and manage. Using tanks can create an extended growing season, necessary in colder climates. Other benefits of tank culture include..controlled environmental factors (turbidity, temperature, waste management), safety from predators, and controlled feed intake--all of which produce maximum growth rate, highly efficient reproduction rates, and the highest possible weight at harvest.
Simple selective breeding can increase the size and disease resistance of successive generations, as in the now famous 'Super Shrimp' of Mexico.

There are over 300 species of freshwater crayfish in the U.S.A...all sizes, colors, temperments. There are several varieties that thrive in almost every environmental niche. Some are better suited for farming than others, and there is a suitable species for almost any climate in the U.S.



Two of the most popular varieties for culture. Both grow to over 1 oz. in weight in one growing season, under optimum conditions of temperature, aeration, density, turbidity and feeding. All easily reached conditions!

Frog Farming

Raising and selling frogs on a commercial basis has **not** proven to be successful economically in Nigeria. Its collection in the wild and cherished as delicacy in some parts of the country have observed especially in riverine areas. Although farming for frog legs sounds promising, operating a profitable frog farm seems to be more of a myth than a reality. Those few individuals who claim to be successful frog farmers generally are distributors engaged in the selling of adult frogs, tadpoles, or frog eggs, frequently harvested from the wild.

Many "frog farms" turn out to be natural in marshy areas, swamps or shallow ponds with abundant food and habitat suitable to the needs of wild frogs at some frog farms.

Culture method

Culture methods simply consist of getting an enclosure whereby the shoreline area is increased and fence are erected to exclude predators and retain the frogs, and stocking is effected by collection of wild frog eggs or tadpoles. The frogs usually are left to raise themselves.

Intensive indoor frog culture techniques have been developed for the production of laboratory frogs used in medical and biological research. At present, however, it is doubtful that these indoor culture techniques can be applied economically to the culture of large frogs for human consumption.

Edible Frogs

A number of species of frogs, including the green frog (*Rana clamitans*), the leopard frog (*Rana pipiens*), and the pickerel frog (*Rana palustris*), are harvested from the wild and sold as a luxury food - frog legs - in expensive restaurants. However, the bullfrog (*Rana catesbeiana*) has the greatest potential for culture.

The common bullfrog, often referred to as the "Giant Frog" or "Jumbo Frog," is the largest native North American species, often reaching 8 inches in body length. Because of its large size, the bullfrog is the most preferred and commonly attempted species for farming.

Breeding and the Life Cycle

Bullfrogs lay their eggs in shallow standing water during the Spring (April and May) in temperate climates. The large, floating, jelly-like egg mass produced by a single female may cover an area about 3-5 feet square and include from 10,000 - 25,000 individual eggs. The eggs hatch in 1 - 3 weeks, depending on the water temperature, into larval frogs that commonly are called tadpoles. Bullfrog tadpoles chiefly are vegetarians, spending most of their time grazing on microscopic plants and bottom algae.

Frogs and other amphibians are coldblooded animals that grow slowly, not a particularly desirable trait for farming. The rate of growth of the bullfrog tadpole varies with the climate, length of the growing season, and available food supply. Even in temperate climates, it may take a year or more to transform the tadpole into a young bullfrog. Another year or more is required to produce a mature, marketable-size bullfrog. Therefore, in the mid-latitude states like Virginia, development from egg to a mature bullfrog of harvestable size may take over 3 years, even under ideal conditions.

Artificial Feeding

Feeding is the critical process in culturing frogs successfully. Poorly fed frogs are susceptible to disease and frequently resort to cannibalism (eating younger bullfrogs and tadpoles), thereby reducing the harvestable population. Frogs and tadpoles reared outdoors will obtain some natural foods, but for intensive commercial culture of frogs in high densities, supplemental food must be supplied.

Bullfrog tadpoles are mainly vegetarians and will consume most soft plant matter and some animal feed. Acceptable tadpole foods include such items as boiled potatoes, meat scraps, or chicken viscera. Recycling butchered frog scraps is a convenient way to reduce food costs, but may transmit disease.

Once the tadpole has metamorphosed into the adult frog (i.e., the legs are fully developed and the tail is absorbed), feeding becomes especially difficult. Adult frogs feed exclusively on **moving animals**, primarily small insects. They generally refuse to eat dead or at least non-moving food. Japanese researchers reportedly have been able to induce frogs to eat dead silkworm pupae by using small motorized trays that mechanically roll the silkworms back and forth to simulate live animal motions.

Live animals, such as minnows, crayfish, and insects, also are placed in these trays to condition the frogs to feeding from these mobile platforms. Although this technique may work, most American frog farmers rely on stocking or attracting live food

animals. Smaller species of frogs, tadpoles, crayfish, and minnows can be stocked as food items for bullfrogs although the expense of live feed is high.

The use of strong flood lights to illuminate the shoreline at night will attract flying insects and provide additional food for frogs. However, this technique is not sufficient to supply enough food to sustain the high frog densities needed for a commercial operation. At present, live food, adequate in quantity and quality, remains the greatest problem for would-be frog producers.

Pond Design

A mature bullfrog may require as much as 7m of shoreline as its exclusive feeding territory. Territorial behavior firmly limits the number of frogs that can coexist in a small area. Available shoreline area (the ratio of land to water edge) is a critical factor. The total size of the pond is not as important as shoreline, because frogs use shallow shore lands to rest and feed. Large expanses of deep, open water are seldom used by frogs.

Regularly shaped round or square ponds have less shoreline in proportion to area than small irregular-shaped ponds. Therefore, increasing the length and irregularity of the shoreline by constructing long narrow ponds with numerous islands, shallow bays, or coves will increase the carrying capacity of frogs in a given area. Some growers increase the amount of shoreline, by constructing ponds as a series of narrow ditches.

Ponds should be deep enough to protect the adult frogs and tadpoles from extremely hot or cold temperatures. Accordingly, the depth of the pond must vary with the climate. In the southern U.S water from 0.4m deep is adequate, but in the North, much deeper water (2 - 4m) may be required to assure the over-winter survival of frogs hibernating in the bottom mud. Pond should have shallow areas because frogs normally rest and feed in shallow waters.

Predatory fish, snakes, snapping turtles, cats, foxes, and water birds that feed on adult frogs and tadpoles should be fenced out. Enclose the pond with a mesh fence about 3 feet high. A vertical fence, topped with wings, one inclined outward and the other inward, will exclude predators and keep frogs in. Birds are especially difficult to exclude, but, in small ponds, a wire net stretched above the shallow shoreline area may offer some protection. Some loss due to predatory animals should be expected.

Water Quality and Quantity

An abundant supply of high quality water must be readily available to the frogs throughout the growing season. For good growth, water temperature should remain relatively constant at 20° to 26° C. The pH of the water should be slightly acidic. Dissolved oxygen always should be present because tadpoles, as fish, breathe by gills and are dependent on the available oxygen. Pesticides and other dangerous chemicals often are toxic to frogs, and even non-lethal concentrations could restrict the sale of frog legs for human consumption. Pesticides can be distributed widely by winds and

water currents. However, with care and intelligent site selection, most pollution problems can be avoided.

Harvesting

Techniques for collecting and harvesting pond-cultured bullfrogs are the same as those used in capturing wild frogs. These methods include nets, hand capture, spearing, and fishing with a hook and line. Hooks baited with live insects, earthworms, or artificial lures (a piece of red cloth or yarn) are dangled in front of the frog. Spearing and band capture techniques are done most effectively at night, using a bright spotlight to momentarily daze and immobilize the frog. Obviously, new methods to efficiently harvest large numbers of frogs need to be developed.

Diseases

The most common disease of frogs, red-leg disease, is due to a bacterial infection (Aeromonas), often resulting from overcrowded conditions. The best preventative methods are adequate nutrition and space. Infected individuals should be isolated immediately, and treated with antibiotics. In severe cases, it may be necessary to drain the ponds and allow them to dry out for several weeks.

Economic Factors

Good management and operational skills are critical to an aquaculture enterprise. The success of aquatic farming depends largely on the cost to grow and market for the product. Before attempting to raise frogs or any other aquatic crop, the prospective culturist should conduct a survey of the local or regional markets to determine the current supply, present and expected demand, price elasticity, extent of competition, and other socioeconomic factors.

Large numbers of wild frogs imported into the United States or captured locally and sold at low prices will reduce the potential profitability of frog farming. Market price fluctuations of frog legs are volatile. Prospective frog farmers realistically should assess their own financial status because most aquaculture enterprises require a high initial investment, have a number of associated "hidden" costs, and produce low realized return on short term investments. **Expectations of large or easy profits are extremely unrealistic.**

As in agriculture, aquatic farming a risky business. A number of unpredictable and uncontrollable catastrophes include prolonged droughts, severe floods, toxic chemicals, intense predation, infectious diseases, and contagious parasites literally can destroy an entire year's crop overnight. Prospective frog farmers should be well aware of these and other associated risks and be prepared to sustain some periodic losses.

At present, there is no well-established frog farming industry in Nigeria. Current practices and past efforts at commercial frog farming have been unsuccessful largely because of physical, chemical, biological, and economic constraints. Opinions

concerning the feasibility of frog farming in Virginia range from the optimistic to those that maintain it is not possible economically.

Considering the current state of the art, frog farming as a **commercial** venture appears to have severely limited potential. However, as intensive hunting and increased drainage of natural wetlands continue to reduce the wild frog populations, the demand for frogs may reach a critical point, permitting skilled culturists to profitably farm frogs.

Declining Wild Amphibian Populations

Wild populations of frogs, toads, salamanders and other amphibians are declining throughout the world. Scientists suspect greater atmospheric ozone and the increased incidence of ultraviolet radiation, acid rain, and other forms of environmental pollution, but the exact causes for the rapid disappearance of frogs and other amphibians are unknown. Researchers fear extinction of many species of amphibians worldwide. This decline will reduce the supply of wild frogs for food and for farming operations. It also may impose new regulations and restrictions on frog farming enterprises.

In Virginia and most other states, it is lawful to capture and possess no more than a few wild native or naturalized amphibians for private use and not for sale. A permit for capturing, holding, propagating, and selling of wildlife, including amphibians, is required in most states.

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