Kentucky State University
Aquaculture Program

KSU's Program of Distinction

Contents

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The Maylasian Freshwater Prawn

has received the most attention from farmers because of its large size.

INTRODUCTION

The United States is the world's largest market for shrimp. Despite this fact, currently there is only very limited production of shrimp and shrimp products within the U.S. In fact, the United States' trade deficit in shrimp products is in excess of $2 billion per year. This has created a great deal of interest in shrimp production within the U.S.

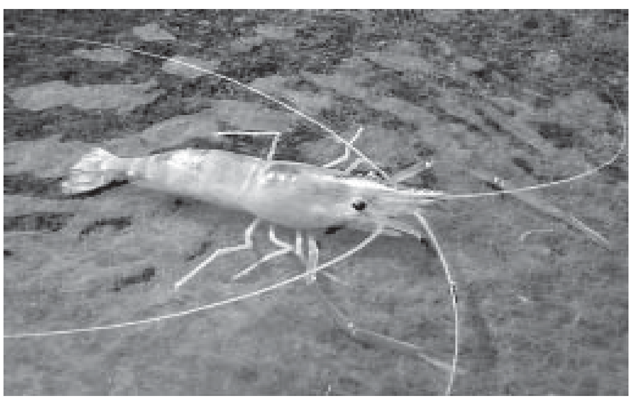


Figure 1. *Farmers in Kentucky and other southeastern states have begun to show increasing interest in growing freshwater prawns in ponds.*

However, due to high land costs, strict environmental regulations along the coasts, and widespread disease concerns, the production of saltwater (penaeid) shrimp has not developed substantially in this country. These factors have increased interest in the production of freshwater shrimp or prawns in several areas of the United States.

Figure 2. Prawns do not appear to be susceptible to most of the viral diseases that have devastated marine shrimp production.

Also, being primarily freshwater organisms, prawns can be produced farther inland, near large urban markets. Freshwater prawns can produce large individual sizes that are in high demand in the market. In addition, freshwater prawn production tends to be more environmentally sustainable (compared with saltwater shrimp production) because freshwater prawns are more territorial in nature, and are stocked at lower densities.

However, this final trait also has been one of the major constraints on prawn production. Compared with many saltwater species, production levels for freshwater prawns have been much lower. Also, at harvest, freshwater prawns tend to have greater size variation than saltwater shrimp, which negatively impacts marketing. This is due to aggressive interactions among different morphotypes, especially males. To increase the commercial viability of prawn production, it is extremely important that production rates be increased, without sacrificing environmental sustainability, or size of the shrimp, and that the individual sizes of freshwater shrimp become more uniform.

NEW TECHNOLOGICAL AND BIOLOGICAL DEVELOPMENTS

Interest in prawn production has emerged at different times in the U.S. over the last 25 years, although long-term, large-scale production has yet to develop. Several technological and biological developments have occurred that may make prawn production in this country more economically feasible. These include:

1) Discovery that prawns can be raised much farther north than previously thought, (and that these conditions can actually increase production).

2) Development of size-grading procedures prior to stocking which increases total production and average weight.

3) The addition of artificial substrate to ponds which can allow higher stocking densities and production rates without sacrificing size.

4) The use of increased feeding rates which can complement these technologies to allow them to achieve optimum production.

NATURAL HISTORY

This section on hatching and nursing prawns is to help the producer understand the animal. Most prawn growers will not hatch or nurse their own seedstock.

The freshwater prawn, also known as the giant river or Malaysian prawn, is native to the tropical Indo-Pacific region. Freshwater prawns belong to the family Palaemonidae which includes the brackish and freshwater grass shrimp and the larger river shrimp.

Most species that comprise this family require brackish water (dilute seawater) to complete the early stages of their life cycle. Due to its large size, relative to other freshwater shrimp, the Malaysian prawn has received the most attention from farmers, investors and researchers as a prospective culture animal in the United States and other countries.

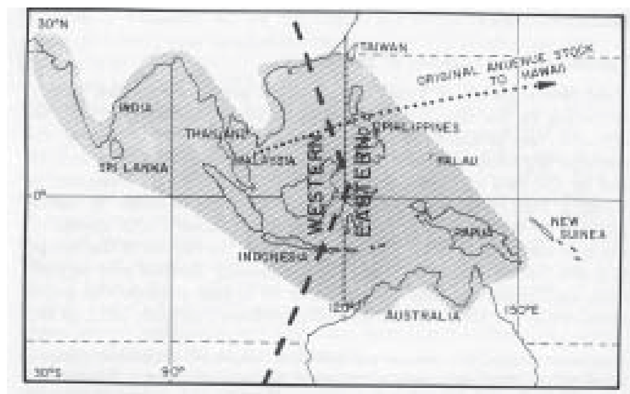


Figure 3. *Freshwater prawns can be found along all coastal areas of the Indo-Pacific region.*

Although prawns have been grown to an individual weight of ½ pound, the weight of farm raised prawns is usually 2 ½ ounces, or less. In the United States, commercial prawn culture began in Florida in the 1970s. During this time, attempts were made to start a prawn-farming industry in other tropical and subtropical regions of the world. Between 1989 and 2000, prawn production worldwide increased over 700%. Production is now valued above $1 billion annually. However, over 98% of production occurs in Asia. Recently, a freshwater prawn industry has begun to develop in Kentucky and other southeastern states.

To reach the postlarval stage, the larvae must undergo 11 molts in approximately 30 days.

Prawns breed and spawn in warm freshwater. Breeding takes place between a soft-shell female which has molted (shed) her shell and a hard-shell male. Using its long claws, the male embraces the female and protects her for 1-2 days until her shell hardens. The male deposits sperm contained in a gelatinous mass between the walking legs of the female.

A few hours after mating, the eggs are laid and fertilized. The female attaches the eggs to the underside of her abdomen where they are incubated. Pleopods (paddle-like abdominal appendages) circulate water over the egg mass to provide oxygenated water and to remove debris.

At first, the egg mass or “sponge” is a bright yellow-orange color, but turns brown near the time of hatching. A 1-oz. female may produce 10,000 to 20,000 larvae 4-5 times a year. Mating typically will occur throughout the year when water temperatures are above 70^{o}F. Hatching occurs in approximately 3 weeks when the water temperature is 80^{o}F. The entire brood hatches in 1 or 2 nights and the larvae are dispersed by the female.

Newly hatched larvae must reach brackish water with salinities of 10 to 14 parts per thousand (ppt) within 2 days, or they will not survive. At this stage, larvae swim upside down and tail first. They feed on zooplankton (microscopic animals), worms, and the larvae of other aquatic organisms.

To reach the postlarval stage, the larvae must undergo 11 molts in approximately 30 days. Postlarvae resemble adult prawns and are about 0.3 - 0.4 inches in length. At this stage, postlarvae typically crawl along the bottom, but also can swim in a forward direction right-side up. Rapid backward movement is made by contracting the abdominal (tail) muscles.

They begin migrating into freshwater 1 to 2 weeks following metamorphosis. Postlarvae are cannibalistic and omnivorous. Insects, animal and plant material and even fecal matter from other organisms may be included in their diet. Freshwater and a wide range of salinities can be tolerated. As postlarvae reach the juvenile stage, their bodies become a blue or brown color similar to adults. On average, it takes 95 to 284 juvenile prawns to weigh 1 oz.

BROODSTOCK

Broodstock prawns are collected during the fall harvest and are kept in tanks filled with water at or above 70°F throughout the winter. The ratio of 2 to 3 males to 10 females is typically used. The total number of juveniles needed for stocking the following year will determine the number of broodstock collected. A 1-oz. female may contain about 10,000 to 20,000 eggs, and only a fraction of these may survive through the nursed juvenile stage. Broodstock are fed either a sinking trout or a marine shrimp feed supplemented with fresh fish or beef liver.

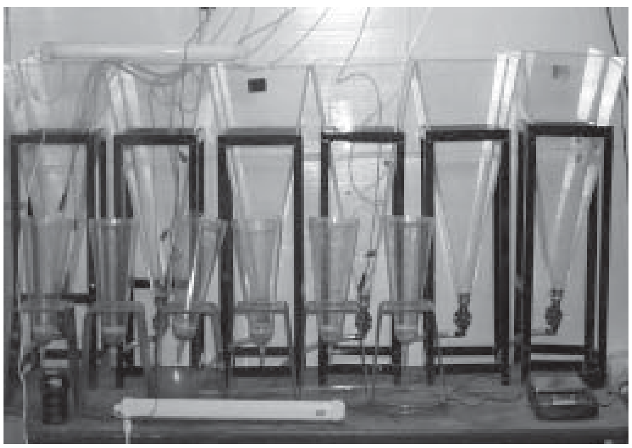


Figure 4. *The brine shrimp, Artemia, are grown in cones and fed to the larvae.*

HATCHERY & NURSERY PRODUCTION

The hatchery and nursery procedures required to grow 30- to 60-day-old freshwater shrimp juveniles for pond stocking are complex. These practices require considerable training, labor and capital expense.

Experienced growers who wish to raise their own seedstock are encouraged to train themselves with a small-scale hatchery and a nursery pilot project **before** attempting larger scale production. Detailed hatchery and nursery methods can be found in "Management Practices for Culture of Freshwater Prawns in Temperate Climates," Mississippi State University, Bulletin 1030, Sept. 1995.

Prawn eggs are hatched from mid-February to mid-March. This is done in order to complete the 30-day hatchery and 30- to 60-day nursery production phases by pond stocking time in late May or early June. Freshwater prawns, postlarvae and juveniles, will not tolerate water temperatures below 60°F. Cold weather restricts the outdoor growing season to 4 to 7 months in temperate climates. In these climates, indoor hatchery facilities are required. Inland production of postlarvae is restricted to brackish water (10 to 14 ppt) recirculating systems which maintain water temperatures of 81° to 85°F.

In the past, most U.S. producers purchased juvenile prawns from tropical hatcheries. Currently, indoor, recirculating hatcheries supply most of the seedstock. A list of nursed juvenile and postlarvae suppliers is available from the Kentucky State University Aquaculture Program (see listing in this manual - page 44 - or on the KSU Web site: www.ksuaquaculture.org).

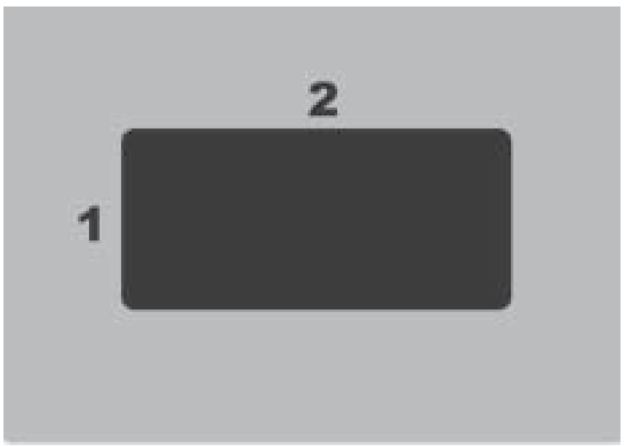
POND DESIGN & WATER SUPPLY

Levee style, earthen ponds, 1/2 to 3 surface acres in size, are well suited for freshwater prawn production. Similar to ponds used to grow catfish, prawn ponds require road access and electrical power (110v or 220v) for aerators. Since prawns are not harvested by complete

With shallow ponds, there is less risk of crop loss due to dissolved oxygen depletion.

pond seining, a prawn pond may be square, round or irregular in shape.

Figure 5.



Rectangular ponds may have a 2:1 length to width ratio which allows good water circulation.

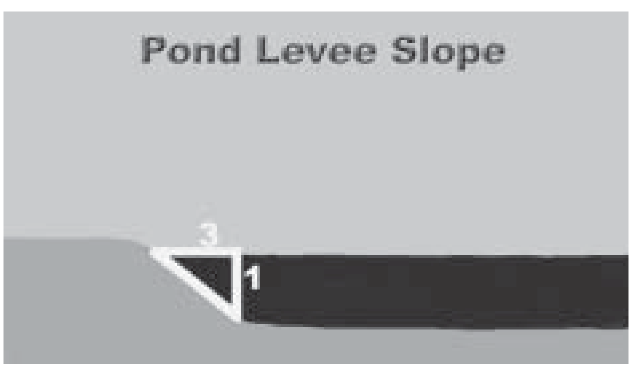


Figure 6.

Minimum and maximum depths of 3' to 6', respectively, should be used. Inside levee slopes of 3:1 will help discourage unwanted aquatic plant and algae growth as well as excessive bank erosion.

Shallow ponds will store less oxygen-depleted water than deeper ponds since their water volume per unit of surface area is less. With shallow ponds, there is less risk of a crop loss due to a dissolved oxygen depletion caused by pond water “turnover.”

Interior Pond Harvest

Prawns are harvested from ponds by draining the water down and concentrating the prawns into a catch basin (or large ditch), then removing them with a small seine. The catch basin should be about 10' to 15' wide with a length about 2/3s the width of the pond.

Catch basin depth should be 18” to 24” deeper than the pond bottom. A 1% to 2% slope of the pond bottom will allow water to drain through a lowered stand pipe (drain pipe) located in the floor of the catch basin. A drain pipe, 8” to 10” in diameter in a 1/2- to 1-acre pond, will facilitate faster draining of the pond and reduce the labor required to harvest the prawns.

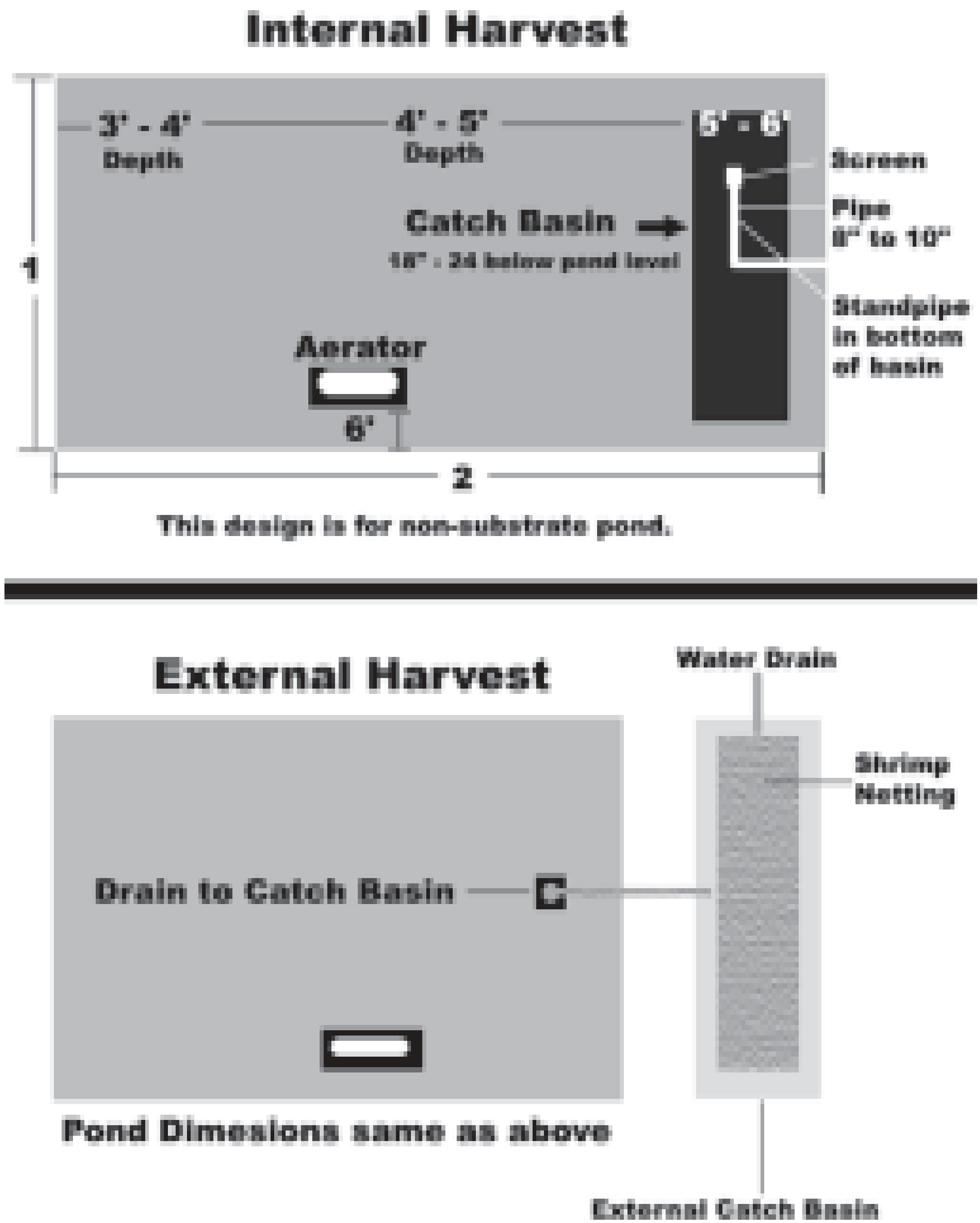

Internal Harvest
3' - 4'
Depth
4' - 5'
Depth
5' - 6'
Screen
Pipe
8" to 10"
Catch Basin
18" - 24 below pond level
Standpipe
in bottom
of basin
Aerator
6'
1
2
This design is for non-substrate pond.
External Harvest
Water Drain
Shrimp
Netting
Drain to Catch Basin
Pond Dimesions same as above
External Catch Basin

Figure 7.

The Use of Well Water reduces the likelihood of introducing unwanted insects into the pond.

Exterior Pond Harvest

Another harvest method is to collect the prawns outside of the pond as they are flushed through the drain pipe. This method requires construction of an additional collection or catch basin outside the pond. The external collection basin should be constructed large enough to hold the entire harvest and should be designed to allow the pond water to flow through, yet retain the prawns in the collection basin. A net pen constructed of heavy seine material that attaches over the drain pipe works well to contain the prawns. This method of harvest also requires an additional source of water for pumping into the pond being harvested, to remove prawns stranded on the bottom or in the drain pipe.

POND PREPARATION

The use of well water reduces the likelihood of introducing unwanted fish and insects into the pond, all of which may prey upon newly stocked prawns. Ground water also is less likely to contain pollutants. Well water sources that provide a minimum of 45 gallons per minute or greater for each surface acre of pond surface can fill or flush a pond rapidly. Ponds should be filled 3 or more days prior to stocking juveniles to inhibit the establishment of predacious, aquatic insect populations. Surface water from rivers and streams may be used to fill the pond 2 weeks prior to stocking, but all water **must** be screened and treated to prevent unwanted fish and insects from entering the pond.

Figure 8.

Figure 9. *Filter socks can be made from plastic window screen and stitched with monofilement fishing line. Shoe shops do an excellent job inexpensively.*

Shallow watershed ponds can be used for prawn production provided fish and aquatic insect populations are eliminated before juveniles are stocked. The pond should not be deeper than 6’ to 8’ and must have a drain. Most watershed ponds do not have additional ground or surface water sources to fill them quickly, and populations of aquatic insects and fish are more likely to become established.

Figure 10.

Predatory fish must be eradicated before juvenile prawns are stocked. Fish may be removed by applying a 1 to 2 ppm solution of 5% rotenone when water temperatures reach 59°-70° F. This should not be done for 2 - 4 weeks before stocking. (Rotenone can be purchased from the Kentucky Department of Fish and Wildlife Resources (502-564-3400).

AERATION & WATER CIRCULATION

The water in most prawn ponds is kept mixed by continuous or nightly aeration/circulation devices. If the pond waters are not mixed, oxygen-depleted water may accumulate near the pond bottom due to thermal stratification. Stratification occurs during the summer when warmer, less dense water remains near the pond's surface.

Sunlight penetrates the upper water layer and photosynthetic activity from phytoplankton (microscopic algae) releases oxygen into the water. Deeper water receives less sunlight and may become cooler and deficient in dissolved oxygen. Cool water is denser than warm water and will remain near the pond bottom (Fig. 12).

Without adequate water circulation, much of the bottom habitat available to the prawns could become unsuitable due to low temperatures and the absence of dissolved oxygen. Since prawns are territorial, this reduction in available living space could lead to reduced survival, smaller shrimp, and reduced pond yields at harvest.

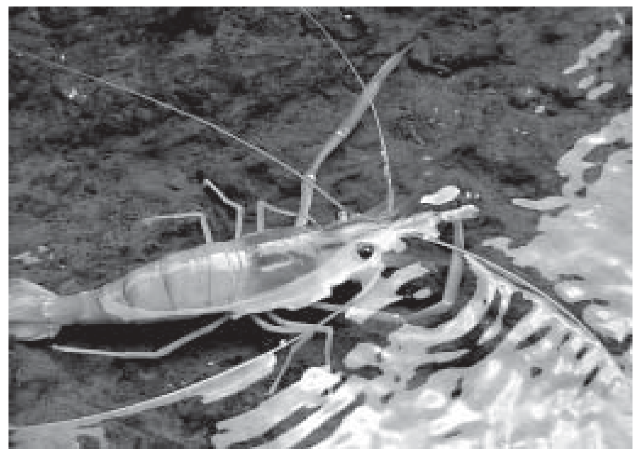


Figure 11. *If freshwater prawns appear around the pond bank, especially in the morning or during the day, there is usually a water-quality problem.*

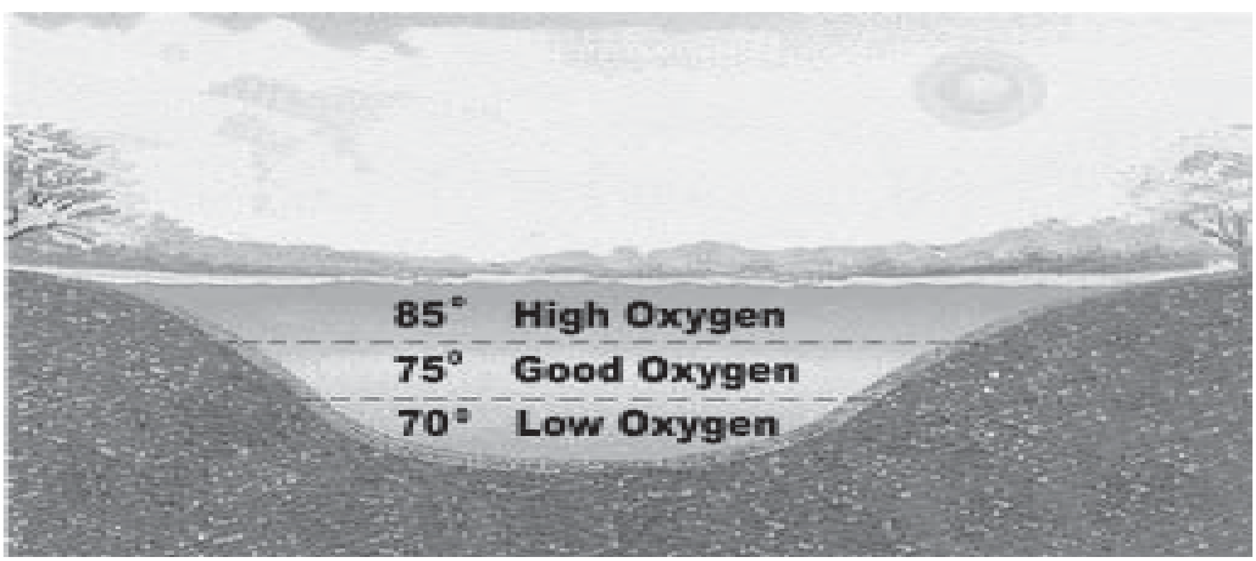


Figure 12. *Continuous low dissolved oxygen levels in the bottom of the pond can result in shrimp mortality. Dissolved oxygen testing is recommended in the early evening hours and before dawn.*

A paddlewheel or aspirator pump-type aerator placed midway along the longest pond levee is recommended for ponds without substrate.

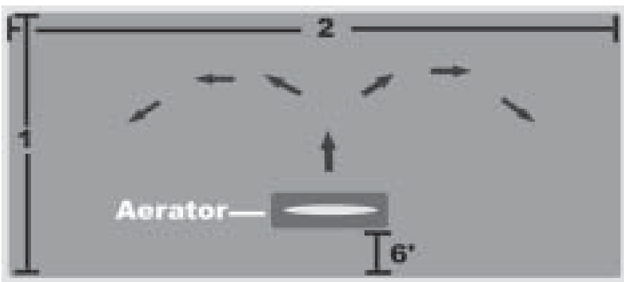


Figure 13. *Ponds without substrate should have the aerator midway along the longest levee, 6' from the bank.*

See page 14 for information and prices on water-quality testing equipment such as D.O. meters and pH meters.

Dissolved oxygen (D.O.) should not be allowed to drop below 3 ppm at any time. Low D.O. may cause prawns to crawl out of the ponds or congregate at the pond edge during daylight. This will increase their vulnerability to predation. Prawns can tolerate temporary low D.O. conditions; however, exposure should be avoided if possible. Dissolved oxygen meters should be used to monitor D.O. in the early evening hours and before dawn. Full-time aeration will reduce the risk of crop loss and keep oxygen-rich water circulating throughout the pond. Since prawns are grown at lower stocking densities and are not as mobile as finfish, water circulation is likely to be as important as aeration.

A pond-side source of 220 volts or 110 volts of electricity should be available to supply water circulation/aeration devices in the ponds. In ponds with no substrate, a paddlewheel or aspirator pump-type aerator placed midway along the longest pond levee is recommended. The aerator should be staked approximately 6 feet out from the bank with its current flowing across the width of the pond. This circulation pattern should send water flow to each end of the pond. Aerators rated at 1 to 4 horsepower per surface acre are used.

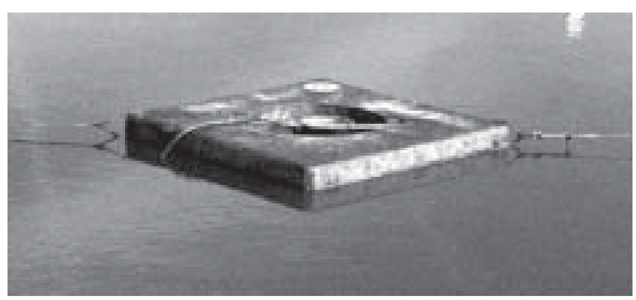


Figure 14. *Vertical pump aerator*

There are many brands of aerators on the market today. Vertical pump aerators are widely used for small ponds of 1/2 to 2 acres in size. The most efficient types lift the water about 18” and move as much water volume as possible. They are light and easy to handle, making installation relatively easy. Also, being domestically produced, repair parts are easier to find. On the downside, vertical pump aerators do not destratify or circulate well, and are only appropriate for small ponds.

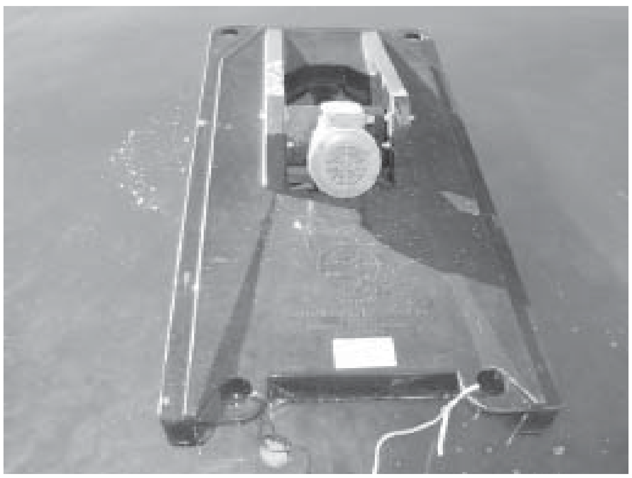


Figure 15. *Propeller aspirator*

Propeller aspirators are widely used in the marine shrimp industry. They can be good in larger ponds, range from 1 to 7 hp in size, and circulate and destratify well. They function by injecting air into the water. This results in less evaporation compared with other areators. A bonus is that they don’t tend to cool the water as much on cold nights. Another consideration is that propeller aspirators move a large volume of water, and require large anchoring devices to hold them in place.

Paddlewheel aerators are the most widely used in the large-pond aquaculture industry. There are two major types. “Taiwanese” paddlewheels are constructed for use in the marine shrimp industry. They are designed for constant circuation and aeration, and are fairly inexpensive and relatively light, making installation easy. However, they are relatively inefficient aerators and can be prone to mechanical problems if not properly maintained. Parts are sometimes hard to get.

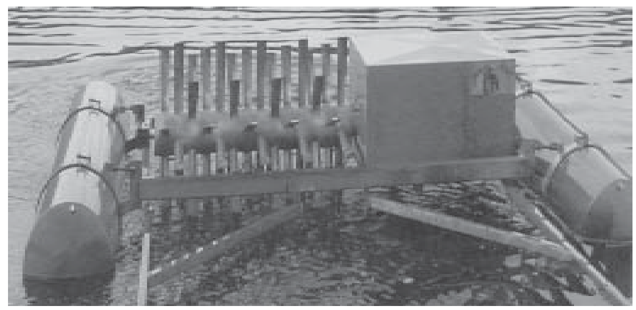


Fig. 16. *Big John is an American-made paddlewheel.*

Electric paddlewheels, such as those used in the catfish industry, circulate and destratify well, and provide very efficient oxygen transfer. They are primarily designed for emergency aeration rather than constant circulation, and are more expensive than the Taiwanese paddlewheels,

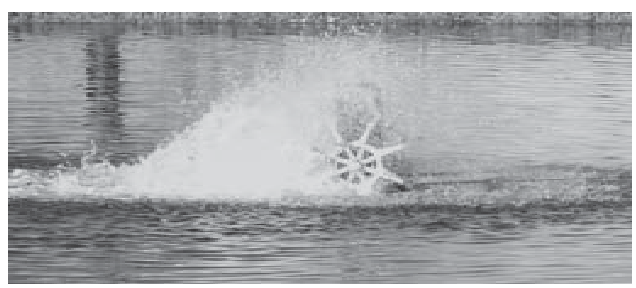


Figure 17. *Taiwanese paddlewheel*

but can be superior in build and longevity. Additionally, parts are easy to obtain so down time is usually short. Negative aspects include higher initial costs, higher operating costs, and their greater weight makes them difficult to install and remove for repairs.

Juvenile prawns may be stocked at a rate of 24,000 to 28,000 per acre with substrate added.

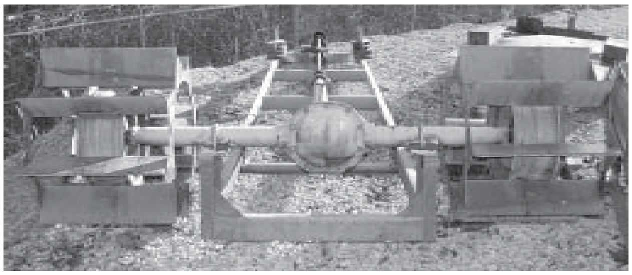


Figure 18. *PTO-driven paddlewheel*

Paddlewheels driven by tractor PTOs are designed for emergency use only. They can be moved from pond to pond as needed, and are frequently used at larger farms with multiple ponds where backup aerators are a necessity.

WATER QUALITY - Dissolved Oxygen

Adequate dissolved oxygen is necessary for the survival and growth of prawns. In aquaculture ponds, prawns are stocked at a maximum density to assure profitability, and the required feeding rate increases as stocking densities increase. In short, morning dissolved oxygen concentrations can decrease as feeding rates increase, making the use of mechanical aerators essential.

Ideal D.O. concentrations in prawn ponds range from 3 to 7 ppm. Prawns become stressed below 2 ppm D.O. and usually die below 1 ppm.

It is important that these minimum oxygen requirements are maintained at the bottom of the pond. If a pond becomes stratified (layered), the bottom layer is typically lowest in oxygen. Aeration, therefore, must not only add oxygen to the water but destratify the pond as well. To ensure that adequate D.O. concentrations and destratification exist, aeration should be run 24

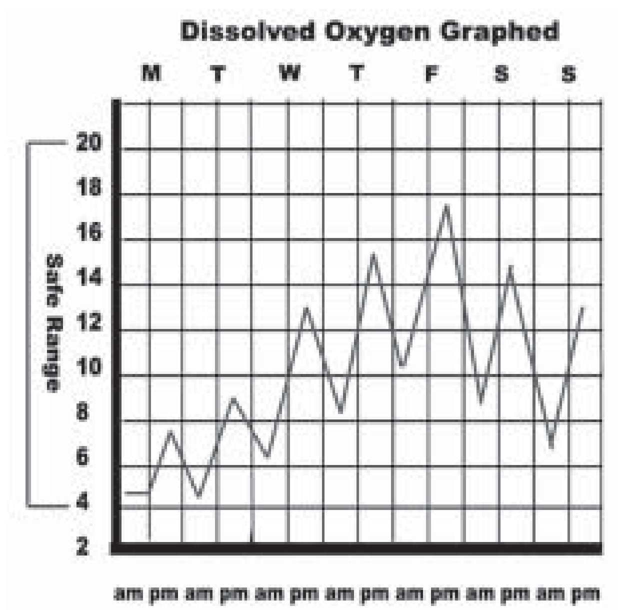


Figure 19. *Graphs for D.O. charting are on page 39.*

hours a day, 7 days a week. It is recommended to begin aeration several weeks before stocking in order to condition the pond. D.O. and pH testing should also begin at this time to monitor the trends and cycles of the pond even before the prawn juveniles are stocked. Throughout the whole season, D.O. should be recorded morning and afternoon, and pH in the afternoon, and both should be graphed to better visualize their positive or negative trends.

Dissolved oxygen should be checked at the low point before sunrise and high point (late afternoon) daily. Oxygen-monitoring times of 6:00 AM and 4:00 PM would be ideal. Avoid a delay in checking morning dissolved oxygen levels - by mid to late morning, D.O. concentrations may have already risen to satisfactory levels, and a possibly dangerously low D.O. reading that occurred at 5:00 in the morning may go undetected. In addition, checking D.O. at dusk and 2 hours later can allow one to predict how low D.O. will drop during the night and when it will occur. If the prediction indicates that D.O. will fall to 1 ppm by 3:00 AM, you will know that additional aeration may be necessary shortly after midnight.

The use of oxygen meters (page 14) is recommended for all aquaculture ventures including prawn production. A reliable, durable, and waterproof D.O. meter is the YSI 550. Less expensive meters are available but may not be as accurate or durable. It is advisable to have your oxygen-testing equipment tested against the university's equipment to make sure accurate readings are being obtained.

Water Quality: pH

Ponds will, at times, have pH levels high enough to stress (9.0) or kill (above 9.5) prawns. This is primarily caused by metabolism of the microscopic plants (phytoplankton) in the pond. Collectively these microscopic plants are known as the pond's "bloom." As all plants do, during the daylight hours, the bloom consumes carbon dioxide (CO_2) through photosynthesis. Since CO_2 in water forms a weak acid (low pH), as it is removed by photosynthesis, the pond pH tends to rise during the day. After the sun goes down, and photosynthesis ceases, pH falls as the plants breath out CO_2. This is a normal cycle of pH rising during the day and decreasing at night (similar to oxygen levels). How high and how low pH will go is primarily controlled by two factors:

1) how dense a phytoplankton bloom the pond has (which is largely controlled by feeding rate) and
2) how well the water is buffered. Buffering capacity is measured by testing the alkalinity and hardness of the water. Your County Agent or State Specialist can help you with these.

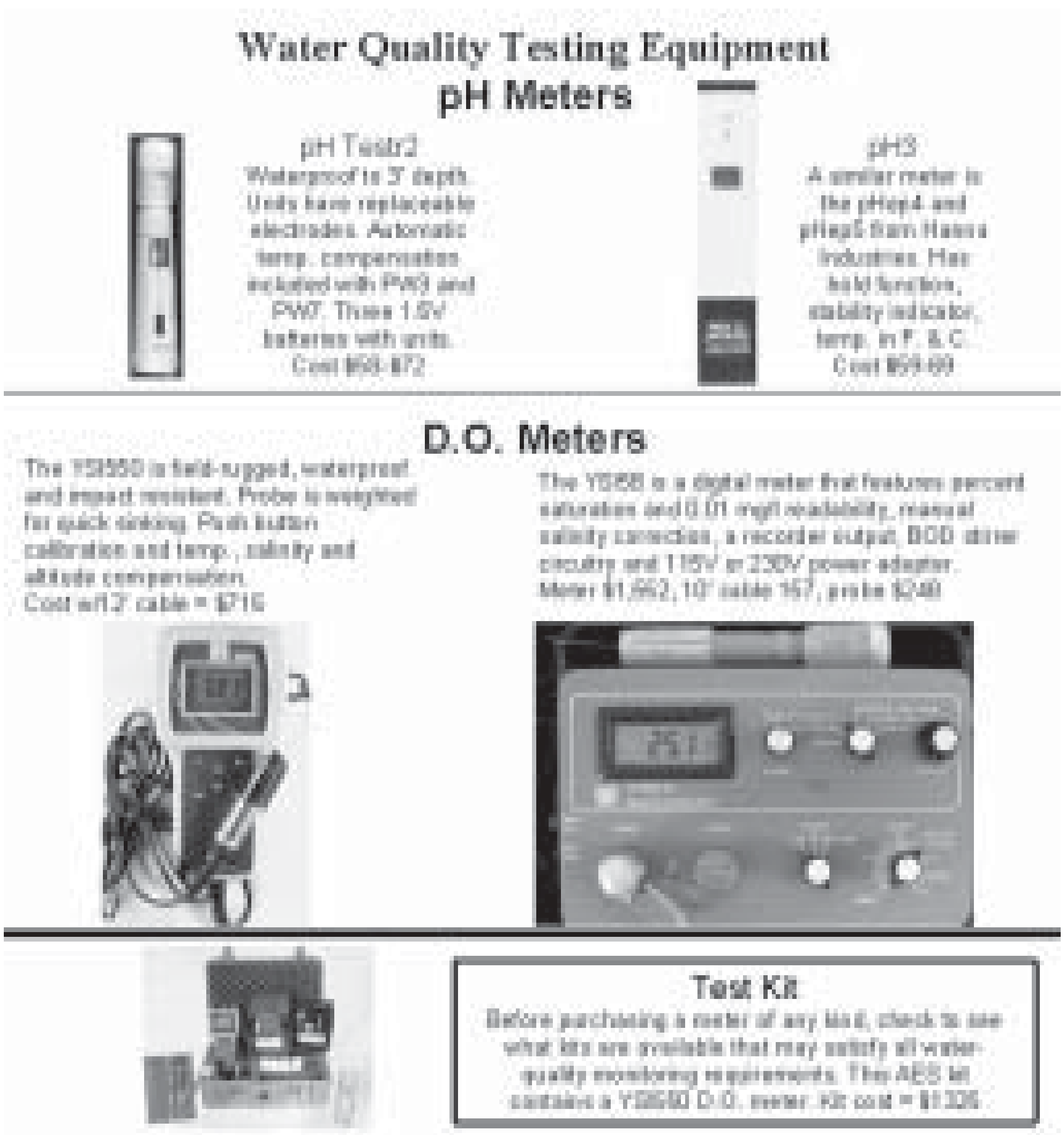
The best way to deal with high pH conditions in the pond is to prevent them. If alkalinity and/or hardness are less than 50 ppm, it may be advantageous to add agricultural lime to the pond at a rate of 1 to 2 tons/acre. This is easiest to accomplish when the pond is empty. If a pond does develop pH levels greater than 9.0, action must be taken. Prawn mortality can occur if levels reach 9.5 to 10.

Specialists at Mississippi State University have recommended adding 30 lbs/acre of cracked

Prices vary and are subject to change. These prices are for planning purposes only. This list of products is provided as a courtesy to readers, and does not necessarily imply a recommendation of the items.

Many Kentucky growers use a Hach FF1-A test kit.

Figure 20.



corn every 2 weeks as needed. The intention here is for the starch (carbohydrate) in the corn to produce CO_2 as it breaks down in the water, producing a weak acid (as described previously) and lowering pH. In Thailand, sugar is used as a purer and quicker dissolving source of carbohydrate. Ten to 20 pounds of sugar/acre/day can be added until pH drops. In North Carolina, gypsum has been recommended. When pH reaches 9.0, gypsum is added at 400 lbs/acre. When pH reaches 9.5, a more immediate response is needed. Other chemicals (such as alum) may be used effectively to lower pH levels, *but a risk of shocking prawns is involved.* Contact an aquaculturist for advice specific to your pond.

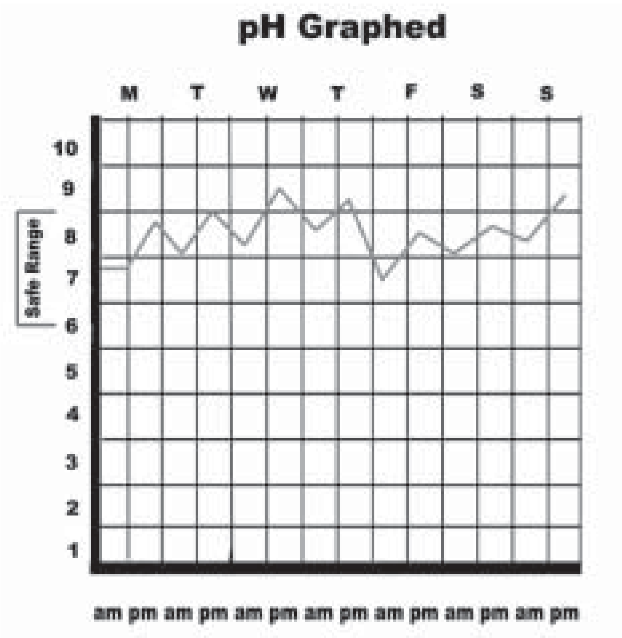


Figure 21. *A pH grid is provided for your use on page 41.*

The best way to deal with pH problems is prevention and preparedness. When building ponds, after the clay is properly prepared with a sheepsfoot roller, put some top-soil back in the bottom. Add 1 to 2 tons of agricultural lime. It is relatively cheap and won't hurt. Add 500 to 600 pounds of alfalfa hay or meal spread over the pond bottom prior to filling. Allow this to break down in the filled pond for 1 to 2 weeks prior to stocking. Always check pH everyday in mid-afternoon. Graph the pH so you can anticipate rising trends before they reach critical levels. Have needed materials on-hand (sugar and gypsum). When you get a pH of 9.5 it is too late to start looking for the things you need.

Water Quality: Ammonia

In prawn production, pond ammonia is produced from excreted wastes and feed decomposition. The toxicity of total ammonia increases as pH and temperature increase.

Total ammonia should not exceed 1 ppm at a pH of 9.0 or 2 ppm at a pH of 8.0. And toxic (un-ionized) ammonia should not surpass 0.3 ppm. Reduced growth and even death may result with long-term exposure to high ammonia levels.

High feeding rates are ultimately responsible for high ammonia levels. Ammonia can be kept reasonably low by not over-feeding, and if high ammonia does occur, flushing with large amounts of water sometimes helps. In certain cases, ponds can be fertilized to enhance the phytoplankton which can indirectly lower the ammonia by consuming it as a nutrient. However, this may increase pH levels. Additionally, the proportion of toxic ammonia can be reduced by keeping pH levels low.

Calcium and magnesium are the most common sources of water hardness.

During the production season, prawn ponds should be checked for ammonia once a week.

Water Quality: Nitrite

Ammonia and nitrite are waste products that come from prawn excretions and decomposed feed. In the early years of prawn production in Kentucky, stocking and feeding rates were low enough that these waste products caused no problem. The new, more aggressive rates now make it necessary for prawn growers to check nitrite twice a week.

Chloride ions in salt (sodium chloride) protect shrimp from high nitrite, so add a 50-pound bag of salt per acre-foot of pond volume at the start of the growing season and maintain this concentration throughout the whole season (adding salt after significant rain, etc.). A 1-acre pond averaging 4-feet deep would get four 50-pound bags of salt. This equals 11 ppm chloride. More salt may be needed if nitrite levels rise above 3ppm.

Water Quality: Alkalinity and Hardness

Alkalinity and hardness are both important components of water quality in prawn production ponds. However, these two aspects of water chemistry are commonly confused. The confusion relates to the term used to report these measures:

- Total alkalinity indicates the quantity of base present in the water — bicarbonates, carbonates, phosphates and hydroxides.

- Hardness represents the overall concentration of divalent salts present (calcium, magnesium, and iron) but does not identify which of these elements is/are the source of hardness. It is important to recognize the difference between hardness and total alkalinity when farming shrimp.

The determination of whether water is acid, neutral or base is defined by pH. Alkalinity measures the total amount of base present and is the indicator of the pond's ability to resist large changes in pH (or buffering capacity). The concentration of total alkalinity should be no lower than 20 mg/L. Pond pH can swing widely, from 6 to 10, when alkalinity concentrations are below this level. Dramatic changes in pH can cause stress, poor growth and even death of shrimp. The suggested range of total alkalinity concentrations for prawn farming is 50-150 mg/L.

Hardness also is important for prawn culture. Calcium and magnesium are the most common sources of water hardness. The critical component is the calcium concentration, referred to as “calcium hardness.” Calcium is essential in the biological processes of aquatic animals. It is also important in the molting process of shrimp and can affect the hardening of the newly formed shell. It has been reported that freshwater prawns can tolerate a wide range of calcium hardness concentrations, but the suggested range is from 50-150 mg/L.

Figure 22. *LOOK AT THIS PRAWN CLOSELY. You may not see another one until the September harvest. Prawns will stay on the bottom of the pond if all is well.*

If aquatic weeds are present in the pond, the best approach is manual removal, using a rake.

Increasing Alkalinity and Hardness in Ponds

If alkalinity and hardness concentrations are below the suggested level, both can be increased by using agricultural limestone (calcite [$CaCO_3$] or dolomite [$CaMg(CaCO_3)_2$]. The use of hydrated lime [$Ca(OH_2$) or quick lime (CaO) is not recommended because either of these compounds can cause the pH to rise very rapidly to levels that are harmful to freshwater prawns. The most reliable way to determine how much agricultural limestone is required is to take soil samples from the pond bottom. Collect the samples the same way you would for cropland and submit them to your county extension agent or a university soils lab for analysis. To get the correct recommendation, indicate that you want the liming requirement suggested for “alfalfa production.” The amount of agricultural limestone needed for alfalfa production should meet the minimum requirement for shrimp production. The best (and easiest) time to lime your pond is before you fill it with water. Agricultural limestone should be distributed as evenly as possible over the entire pond.

When pond alkalinity concentrations are below 50 mg/L, agricultural limestone can be used to raise alkalinity and hardness. If total alkalinity is above 50 mg/L, agricultural limestone will not increase hardness. In this situation, or where hardness is not caused by calcium, agricultural gypsum (calcium sulfate) can be used as an effective way to bring calcium hardness to the desired concentrations. The addition of 5.5 lb of agricultural gypsum per acre-foot of water will raise calcium hardness (and total hardness, mg/L $CaCO_3$) approximately 1 mg/L. It is important to match calcium hardness with total alkalinity concentrations to help stabilize pond pH.

Temperature

The optimum temperature range for prawns is 77º – 90º F (25º – 32ºC). Although the average summer temperature range in Kentucky is at the lower end of this range, there is an advantage because the lower temperatures delay many of the prawns from reaching sexual maturity, and more energy goes into growth rather than into sexual development.

Survival is shortened below 66º F (19º C) and above 94º F (34º C), and death occurs quickly at 55º F (13º C). In early October of 2000 and 2001, several prawn ponds were lost to low temperatures just days before harvest, costing the farmers thousands of dollars in lost revenue. In Kentucky, prawns should be harvested by the end of September to make sure this does not recur.

AQUATIC WEED PREVENTION

Aquatic weeds are very difficult and expensive to treat; the success rate for aquatic herbicides can be as low as 50%. Prevention, by far, is the best approach to aquatic weed control, and the following steps can be taken to aid in this prevention:

- Keep the shallow end of ponds at least 3' deep.
- Build the levees (dams) of the pond with a 3:1 slope (to prevent extensive shallow areas along the pond edge).
- Maintain an adequate green phytoplankton bloom to prevent clear water (Clear water permits sunlight penetration that can start aquatic weed growth).

STOCKING JUVENILE PRAWNS

In Kentucky, juvenile prawns are typically stocked in ponds in late May or early June when average pond temperatures consistently exceed 68^{o}F. In ponds without substrate, 16,000 to 20,000 juvenile prawns are stocked per acre (3.34 juveniles/yd^2) to obtain 1- to 1 1/2- oz. prawns by mid-September after approximately 120 days.

A lack of reliable sources and the high cost of juvenile prawns have been a major industry constraint. The cost to stock 1 acre with 16,000 juvenile prawns which are 60 days past postlarvae is approximately $1,600. These costs may not, but should, include packaging and transportation.

Due to the relatively short growing season in temperate climates such as Kentucky (100 -140 days), it is important to stock juvenile prawns that are large enough to ensure they will reach market size within that period. Prawns should be 0.25 g (about 1") when stocked. Prawns can reach this size from postlarvae in 30 days if stocked at a relatively low density in nursery tanks 20 ft/^{2} (10 animals/gallon) or in 45-60 days if stocked at higher stocking densities such as 40/ft^2 - 80/ft^2 (20-40/gallon), respectively. Juvenile size depends on stocking density and duration in nursery tanks as well as many environmental and nutritional factors.

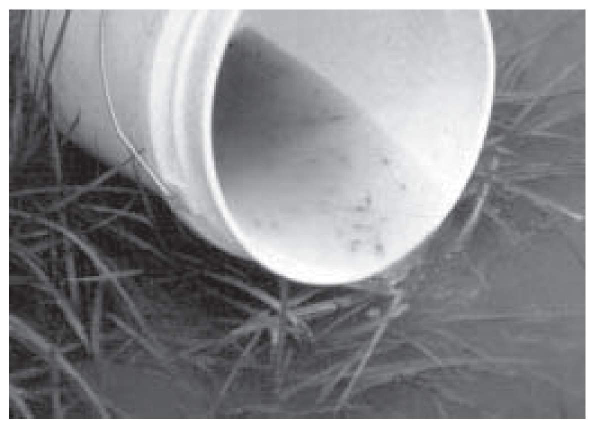


Figure 23. *Prawns should be acclimated to the pond water before stocking.*

The actual size of the juvenile is the most important variable; however, age may affect the number of reproductively mature (blue claws and egg carrying females). Older animals at stocking will have a higher percentage of mature animals at harvest, although they may not necessarily be larger.

The stocking of juveniles, rather than smaller postlarvae, generally reduces stocking mortality & increases yield.

Farmers should ensure that the stocker prawns they are purchasing have been in the nursery at least 30 days. Prawns should weigh 0.5 - 1.0 lb/1,000 animals (0.25 - 0.5 g) when stocked. Weigh some samples prior to stocking to ensure prawns are of proper size.

To compensate for the short growout season in temperate climates, 30- to 60-day advanced-juvenile prawns (approximately 57 individuals per ounce) are stocked as opposed to the smaller, less expensive postlarvae. This practice generally reduces stocking mortality and increases yields. Without additional pond substrate, stocking densities in excess of 20,000 juveniles per acre typically result in smaller prawns with less market value.

Size-grading juveniles into separate weight classes prior to pond stocking has been shown to increase yields and reduce the number of smaller prawns of less value. Homogeneous prawn growth will likely result in increased returns. A small box grader with appropriately spaced bars (1” to 1.5”) can be used to grade the prawns.

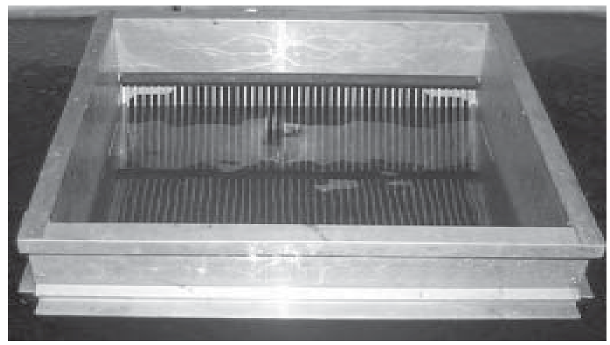


Figure 24. *The use of a grader box should result in a more uniform harvest.*

Before stocking, the pond water temperature must be at least 68°F (and rising). Juveniles must be temperature acclimated from the transport water to that of the receiving pond. There should be no more than a 5°F difference in the temperatures of the hauling container and the pond. Prawns can be acclimated by gradually replacing the transport water with pond water over a period of 20 to 30 minutes. If juveniles are transported in plastic bags containing oxygen, the bags should be floated in the pond for at least 5 minutes in the shade or during periods of low sunlight. A quart of pond water is added to the bags every 5 minutes to allow the prawns to adapt to the pond’s water quality.

TRANSPORT METHODS

Successful prawn production starts with getting healthy animals into the growout pond. Prawn juveniles should be stocked in hauling tanks at densities no greater than 1/4 lb of prawns/gallon of transport water, for up to 6 hours. Higher stocking densities will result in the deterioration of water quality and increased cannibalism in transport containers. If prawns are to be transported for greater periods of time the density should be reduced accordingly.

It is important to fill the transport container with cool (70°-72°F), clean, aerated water. Prawns must be gradually acclimated from the nursery tanks into the hauling water, which is usually cooler. It also is very important to acclimate the prawns to pond water prior to pond stocking. Variations in pH, alkalinity, hardness and other water quality variables between transport containers and pond conditions affect the condition and survival of prawn juveniles in the production pond. To acclimate prawns in a hauling tank, first drain 50% of water from the tank and add an equal amount of pond water. Allow 10-20 minutes for prawns to acclimate before stocking into the pond. If temperatures are not within 2-3°F, repeat the procedure.

Figure 25. *Prawns in tank trucks must be acclimated before stocking.*

SUBSTRATE

Field trials are being conducted to determine if the addition of artificial pond substrate is economically feasible to increase prawn habitat and per-acre prawn yields. The addition of substrate allows the stocking of more prawns and may increase pond yields by 20% to 40%. Individual prawn size may also increase.

Plastic, high visibility, barrier, safety fencing may be used as substrate. Vertical rows of fencing are anchored lengthwise within the pond. With substrate, juveniles may be stocked at a rate of 24,000 to 28,000 per acre. Increased water aeration/circulation and feeding may be required. With added substrate, aerators are placed midway along the short side of the pond, so that water movement is parallel to the substrate.

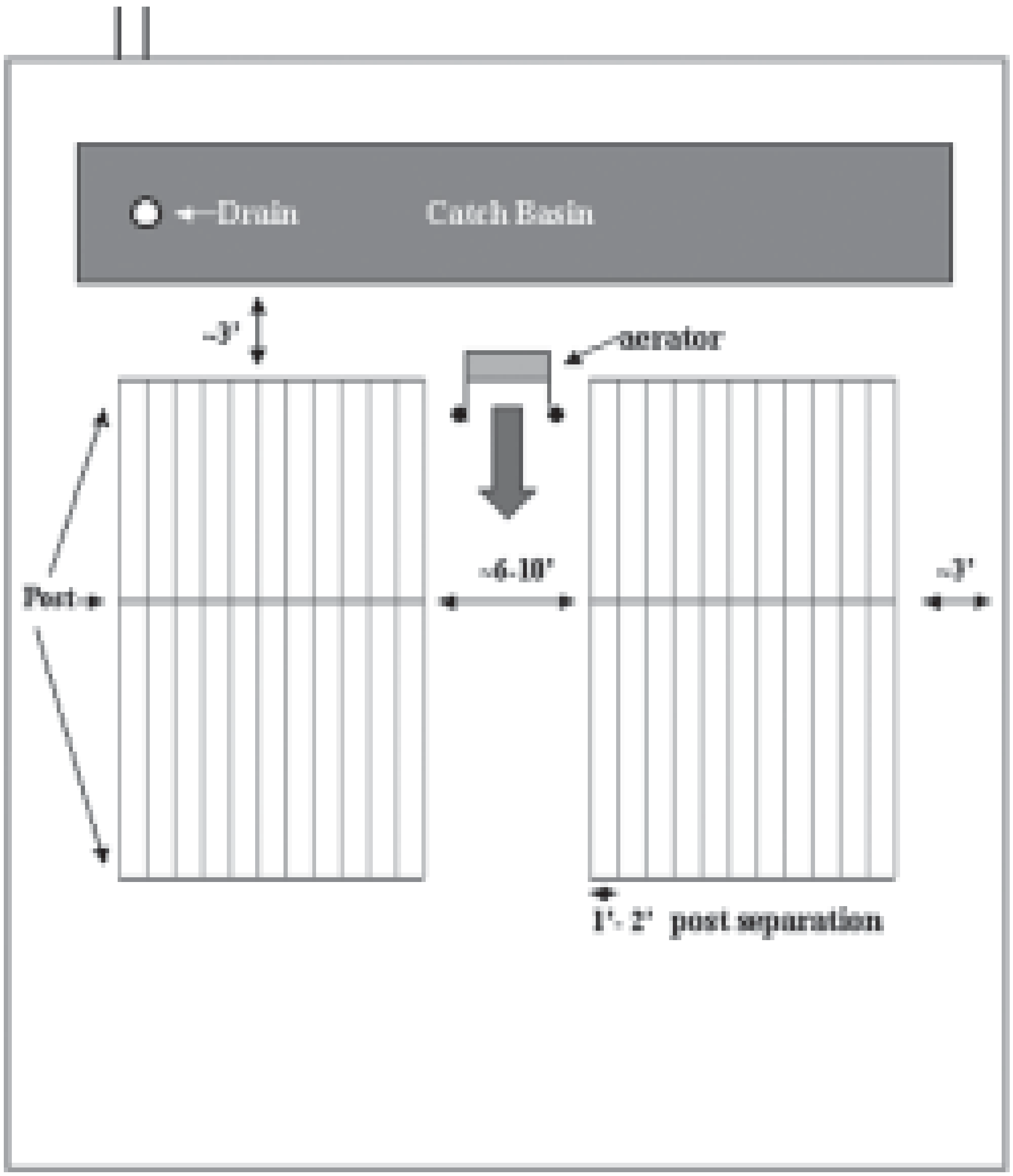
Figure 26. *Substrate should be tied firmly to posts using 5 cable ties on each post. Posts should be about 45' apart.*

Substrate Installation

Parallel rows of substrate should be spaced 1'-2' apart, and run lengthwise in the pond. Each 90' row of substrate will be attached by

First-time growers might want to wait until the second year to install substrate.

Figure 27.



cable ties to three posts. Although the barrier fencing (substrate) comes in 100' lengths, it is better to set posts for only 90' as many times the substrate sections come closer to 90' than 100'.

There should be a 6' to 10' empty space – substrate free — directly in front of the aerator, running the entire length of the pond. This will assure better water circulation.

Set all posts 3' away from the inside of the catch basin. Allowing for the 6' to 10' space in the center of the pond, set the first post closest to the aerator, and walking toward the closest pond bank, place posts every 1'-2'. The last post set should be no closer than 3' to the bank, on flat ground -- not on the slope of the levee.

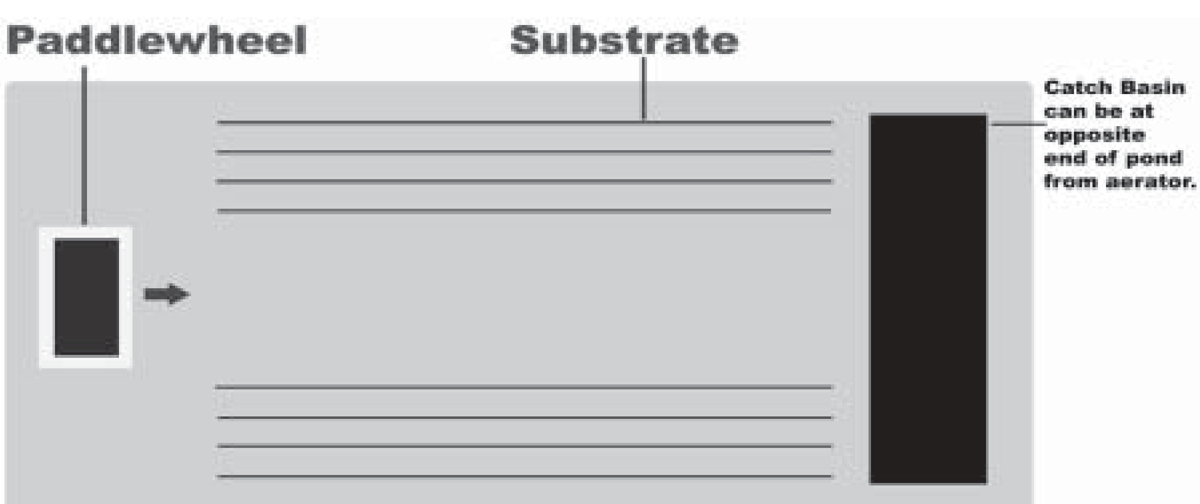
Go back to the center of the pond, 3' from the catch basin, and again allowing for the 6' to 10' center space, set posts every 1'-2' as you move to the other side of the pond. When finished, there is a single row of posts 3' away from the catch basin and 1'-2' apart, stretching the entire width of the pond.

Stand at 1 of the 2 inside-most posts and run a tape measure 45' (lengthwise of pond) and place the second post for that row at that point. Then measure another 45' and place the third post for that row. Follow this same procedure for each row, as you move toward the pond bank. After completing the last row, which should not be closer than 3' to the bank, repeat this process on the other half of the pond.

"T" posts should be driven at least 12" into the ground, or until secure enough that they do not sag under pressure. Starting in the deep end of the pond (near catch basin), and at the post closest to the bank, attach the substrate to the posts using 5 cable ties per post.

Place the fencing material 6" to 12" off the pond bottom to allow prawns to walk unobstructed toward the catch basin during harvest. Now, roll the substrate to the second post (45' away), pull tightly to get rid of any sag in the substrate,

Figure 28.



Prawns are bottom feeders that use smell, taste and feel to find their food.

then attach to the post. Repeat the same process, attaching the substrate to the third post (90' from the first post). All remaining rows of substrate will be put up the same way. It should not be necessary to add weight to the substrate to keep it from rising up, if it has been properly attached to posts with cable ties.

Note: KSU personnel have found the installation of substrate to be faster and the rows to be more uniform if flags are first positioned where posts are to be located, or another approach is to mark the post sites with a can of spray paint. Once aligned properly, posts are driven at the flag or paint locations.

FEEDS & FEEDING

It is important to understand the feeding behavior of prawns in order to efficiently provide feed in growout production. Prawns are bottom feeders that find their feed mainly by smell, taste and feel, rather than eyesight.

Freshwater prawns are omnivorous scavengers that feed on a variety of bottom organisms and organic materials (detritus). The food habits of prawns vary during different life stages. The juveniles that are initially stocked in growout ponds eat all types of plant and animal matter; however, as they grow, their food habits change and they become more carnivorous, feeding primarily on slow moving snails, worms and insects.

In pond production of freshwater prawns, the total weight of prawns in the pond is quite low for the first 30 to 40 days. Fertilizer materials can be used during this period to increase the production of natural foods.

After the first 30 to 40 days, one should feed a sinking feed that contains ingredients with a lot of taste, such as fish meals and fish oils. Once food is located, it is chewed to a suitable particle size before being swallowed. This causes loss of nutrients from processed feed to the water (i.e., leaching) and increases the need for pellet stability.

Because prawns are very slow eaters, and feed more or less continuously, multiple daily feedings are desirable. Breakdown of the feed and leaching of nutrients can be minimized through multiple daily feedings.

Freshwater prawns are aggressive and will distribute themselves evenly across the pond bottom. Unlike fish, prawns are territorial and do not swim great distances to get food. As a result of this behavior, it is important to uniformly distribute the feed over the entire pond area.

For small ponds (less than 1/2 acre) or where labor is relatively inexpensive, feeding is done by hand. In larger ponds, feeds are offered by the use of boats or feed blowers.

Diets used for freshwater prawns range from inexpensive organic fertilizers, such as distillers' grains (less than $150 a ton), to expensive, highly refined 40% protein marine shrimp diets ($500 or more per ton). As the poundage of prawns increases in the pond, it is more important to provide high quality, nutritionally complete diets.

Local feed mills can manufacture nutritionally complete pelleted feeds of 32% protein; however, steam pelleting generally only produces a pellet that remains stable for approximately 10 minutes. Commercially available marine shrimp diets are manufactured through an extrusion process that increases pellet stability up to several hours.

Recent Feeding Research

Recent research has shown little production advantage from using high-quality, expensive marine shrimp diets compared to locally produced steam pelleted diets when prawns are fed twice daily. However, it appears the higher protein diets do slightly increase the percentage of large high value animals (~ 5% increase) and may be more important when prawns are fed only once daily, or in newer ponds with relatively little natural productivity.

Prawn Growout Feed Formulation (KSU #2)

Ingredient	Percent	Lbs / ton
Menhaden fish meal (67%)	7.5	150
Soybean meal (44%)	15	300
DDGS	40	800
Wheat flour	13	260
Meat & bone meal (54%)	8	160
Ground corn meal	5.25	105
Mineral mix	0.1	2
Vitamin mix	0.1	2
Choline cloride	0.05	1
Dicalcium phosphate	0.5	10
Cod liver oil	0.5	10
Bentonite	5	100
Lignosulfonate	5	100

Table A.
Note: DDGS = dried distillers' grains with solubles

The feed chart on page 27 is based on a 1-acre pond.

Table 1 is a feed chart based on an assumed growth projection from sampling data at KSU's research facility. The feed chart is based on a 1-acre pond. If you have a 1/2-acre pond - cut the daily ration in half. It is best to divide the total daily amount of feed into two feedings (½ daily ration, AM & PM). With full-time aeration of at least 1hp/acre, producers can feed as much as, but should not exceed, 60 to 75 pounds per acre per day of a 32% to 45% protein feed by mid-August.

Table 2 is an alternative feeding chart showing the percentage of body weight the prawns should receive daily, based on the total biomass density of the prawns in the pond.

To determine the biomass density it is necessary to seine the pond and determine an average weight by dividing the total weight of prawns sampled by the total number of the prawns in the sample. Estimate total biomass by multiplying the average weight by the number of prawns that were stocked into the pond.

Table 3 is a list of Kentucky-based suppliers of shrimp feed.

Figure 29. *It is possible to feed shrimp by hand in smaller ponds of 1/2 acre or less. But larger ponds require feed distribution by a blower or boat.*

Feed Tables and Suppliers

Table 1. Daily Feed Amounts (lbs/acre/day)

Month/Day	6/1-6/30	7/1-7/15	7/16-7/31	8/1-8/15	8/16-8/31	9/1-9/15	9/15-9/30
20-25k prawns/acre with substrate	25 lbs/day	40	50	65	75	75	65
12-18k prawns/acre without substrate	25 lbs/day	30	40	50	60	60	50

Table 2. Weight-dependent feeding rates for semi-intensive and intensive production of freshwater prawns

Daily Feeding rate (percent of body weight/day)[a]

Mean wet weight (g)	Semi-intensive 12-18k/acre without substrate	Intensive 20-25k/acre with substrate
<5	20lbs/acre	25 lbs/acre
5-15	7% biomass (lbs prawns)	10% est. biomass (lbs prawn)
15-25	5	7
>25	3	7[b]

(a) lbs of feed=$\left(\frac{\text{Feeding Rate \%}}{100}\right)$ X weight of prawns in the pond

(b) Not to exceed 75 lbs/acre/day

Table 3. Kentucky distributor/manufacturer of freshwater prawn feeds

Distributor/Manufacturer	**Telephone**	**Product**
Bagdad Roller Mills	800-928-3333	KSU Formulation Shrimp Feed
Farmers Feed Mill	859-255-7602	KSU Formulation Shrimp Feed
Bluegrass Shrimp Co.	859-371-2583	Marine Shrimp Feed

In Kentucky, prawns must be harvested in September, before water temps. drop below 60° F.

HARVESTING & YIELDS

Harvest

Research conducted in South Carolina, Mississippi, and Kentucky has shown juvenile prawns will grow to a harvestable size of 1 to 2 ounces in 100 to140 days. Research in Kentucky has indicated cooler water temperatures of 77°to 82°F may delay maturity in the female population which apparently determines the rate of maturation of the male prawns.

At lower water temperatures, dominant males mature more slowly which reduces their ability to suppress the growth of smaller males in the pond. As a result, the prawn population, as a whole, grows larger.

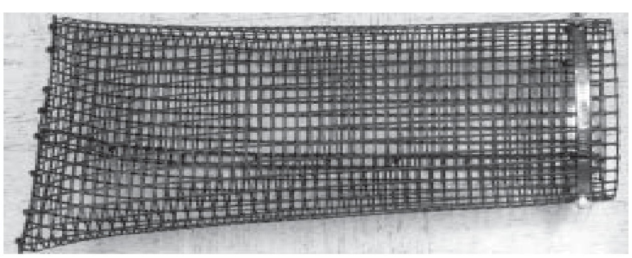


Figure 30. *A standpipe screen should be placed on the pond drain pipe to catch prawns that may be washed through with the exhaust water.*

In Kentucky and other temperate climates, the selective harvest of large prawns may not be practical due to the short growing season. In some instances, small numbers of prawns may also be harvested with cast nets or baited crayfish traps.

Following harvest, prawns should be purged in tanks of warm, clean water (chlorine free) for 5 to 10 minutes. Purging will remove mud from the gill chambers and provide a cleaner product either for live storage or processing. More information on post-harvest handling is given later in this manual.

Yields

Prawns are harvested in Kentucky through September but always before water temperatures reach below 60°F. Overall, survival may vary between 60% to 80%. Yields for mono-cultured prawns range from 500 to 1800 pounds/acre/year throughout the world.

Multiple prawn crops in Taiwan are estimated to yield averages of 2,220 to 2,670 pounds/acre/ year, while single crop production without additional substrate averages approximately 600 to 1,000 pounds/acre/year in Kentucky. Research experiments have shown the potential to double pond yields by the addition of substrate and more juveniles. In some cases, more feed and increased pond aeration may be required to support the increased prawn production.

FACTORS AFFECTING PRODUCT QUALITY AND SHELF LIFE

When life ends, degradation begins. Not a pleasant thought, but a fact nonetheless. However, a few major factors affect the rate at which a product loses quality. The processes that must be addressed and controlled or slowed are primarily caused by bacteria and enzymes. One way to deal with bacteria is to wash the prawns well. The muddy water from a prawn harvest contains bacteria that must be effectively washed away as soon as possible after harvest.

The enzymes involved in product breakdown are primarily digestive enzymes located in the prawn's head. When alive, these enzymes help the prawn digest its food. After death, they can also "digest" the prawn's tail meat if the process is not interrupted. These enzymes also can cause the tail meat to become mushy in texture.

Freshwater prawns are much more susceptible to this problem than marine shrimp, and lack of understanding of how to deal with this has caused serious marketing problems in the past. However, once one knows how to deal with these enzymes, prawns can be stored as long or longer than marine shrimp.

To prevent both bacterial and enzymatic degradation, prawns must either be kept alive or chilled. Lowering the temperature slows bacterial growth and reduces enzyme activity. If the prawns are not kept alive, chill them thoroughly and quickly.

The best way to prevent mushiness is to quickly remove the head. However, some markets pay premium prices for whole animals.

Figure 31.

POST-HARVEST HANDLING

The specifics of how freshwater prawns are handled after harvest can vary based on the type of market being addressed (e.g., live, whole-on-ice, frozen tails). Product quality can be affected by how the animals are treated during harvest. Prawns should be removed from the ponds in a healthy state and as clean as possible to achieve optimum product quality, no matter what the product form.

Prawns tolerate harvest conditions best when water temperatures are 70°- 72°F. Oxygen levels should be monitored during pond draw down because oxygen stress during harvest can affect product quality later. Oxygen levels become most critical when prawns are concentrated in the catch basin. A small surface agitator-type aerator running in the basin can help to maintain adequate oxygen levels. The ability to flush clean oxygenated water into the catch basin during harvest is also helpful.

Processed prawns yield about 50% edible tail meat.

Prawns should be moved as quickly and efficiently as possible into “purge tanks.” These are tanks of clear, clean, aerated water adjacent to the pond where the animals can have the mud washed off. It is helpful to have a series of 4 to 8 tanks where the animals can be dipped and cleared of surface mud, while still in the harvest baskets. Then they can be moved to other tanks with cleaner water and allowed to swim freely, removing mud under the carapace. To accomplish initial cleaning as described approximately 2,000 to 3,000 gallons of clean, aerated water are needed for each 1,000 pounds of shrimp to be harvested.

LIVE MARKETS

There is demand for live prawns, especially in gourmet and ethnic markets. However, prawns can be difficult to hold and transport live because they are aggressive and territorial. Live prawns have been sold at wholesale prices ranging from \$4.00 to \$8.00 a pound, while final retail prices of \$10.00 to \$22.00 a pound have been reported.

Live prawns must be marketed quickly before cannibalism occurs in holding facilities. If prawns are to be picked up by a live hauler, pick-up should be scheduled at most 1 to 2 days after harvest. Tanks should be held at 70^{o} to 72^{o}F and must not be allowed to drop below 65^{o}F during the night.

The tank should be well aerated and artificial substrate should be provided at a rate so that each animal has about 1 square foot of surface area. Layers should be installed at least 4” apart to allow access for the prawns.

Figure 32.

Prawns that have recently molted or are about to molt are likely to be lost to cannibalism in holding tanks. This can account for up to 10% of the harvested crop. Such a loss has a significant impact on profitability. Any animals which appear weak, soft-shelled, or approaching a molt, should not be placed in the holding tanks but should be sold whole or on-ice, de-headed on-ice, or cooked and consumed.

POND BANK SALES

Even if animals are to be sold fresh on the farm, product quality is enhanced if those animals are quickly and humanely killed, their body temperatures lowered as far and as quickly as possible, which is most efficiently accomplished by chill-killing the animals in an ice bath.

This can be an additional tank of clean, clear water with sufficient ice added to create a slurry. To chill-kill and thoroughly cool prawns will generally require about 1 to 1½ pounds of ice for each pound of prawns harvested. Prawns should be left in the tank approximately 15-30 minutes to allow sufficient chill time. Longer times are not recommended because long exposure to the water can affect tail meat texture.

When placing prawns into the chill tank it is helpful to contain them in baskets or a mesh enclosure. If mixed in with the ice, weighing prawns for customers is complicated by the presence of ice in the weigh basket.

Once prawns are thoroughly chilled, they can be placed on drained ice for delivery or customer pick-up. Shaved ice is best. The insulated container should have a thick layer of ice on the bottom, with no prawns, to protect them from contacting the water. The container is then packed with alternating layers of prawns and ice. However, the bottom layer and top layer should always be ice. Whole prawns can be held on drained ice for 2 days. De-headed prawn tails can be held on drained ice 4 to 6 days, although Mississippi researchers have reported as long as 12 days.

Figure 33. *Pond-side sales can be profitable but are limited to persons living in the immediate area.*

FRESH TAIL MARKET

While certain markets will pay a premium for live or whole product, other markets insist on tail-only product. Even for on-farm sales, many individuals desire to buy high quality, locally produced products but are not willing to process the prawns. However, de-heading the prawns is extremely simple. For a tail market, all the harvest, washing, and chill-kill steps previously described apply. To de-head, simply grasp the head in one hand, the tail in the other, and pull and twist.

HANDLING & PROCESSING

Processed prawns yield approximately 50% edible tail meat. Retail prices received for tail meat have been reported between $12.00 to $20.00 per pound. According to researchers in Mississippi, more profits can be made by selling the prawns whole as opposed to de-headed.

Where headless shrimp or prawns are sold, the freshwater prawn can be distinguished from that of the marine shrimp (family Penaeidea). The freshwater prawn's second tail or abdominal segment (which is closest to the head) overlaps

Decide how to market the prawns before the harvest because that will determine how to handle them pond side.

the first and third segments, while in marine shrimp the second abdominal segment is overlapped by the first.

PROCESSING REGULATIONS

Inspected food-processing facilities must be available if processed prawns are to be sold. Altered products, including headed, peeled or value added prawns will require processing facilities which meet local health and/or FDA standards. And a food safety plan called a Hazard Analysis and Critical Control Points (HACCP) plan should be implemented. If these products are sold to the end user or customer, an approved facility is needed, but a HACCP plan is not required.

If sold wholesale to a distributor, a restaurant, or via interstate commerce, the processing facility must comply with HACCP regulations. Unaltered prawns, such as those sold live, or those sold whole-on-ice are not covered by HACCP regulations, unless they are sold in interstate commerce.

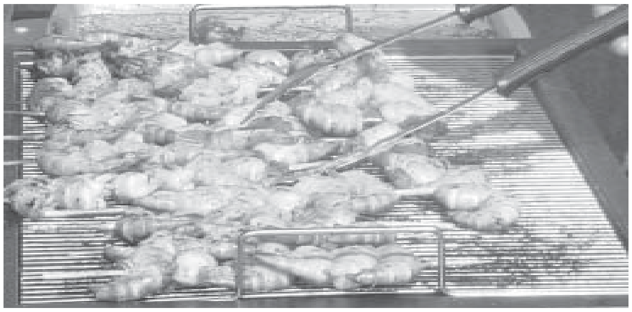


Figure 34. *Special attention should be paid to processing. All HACCP regulations should be observed. One instance of bad product being served can hurt the entire industry.*

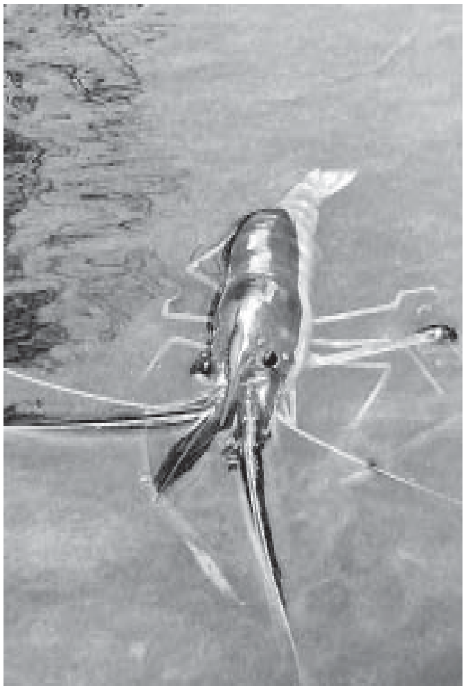


Figure 35. *Post-harvest handling is important. Prawns should reach the processor in good shape if the resulting product is to be tasty.*

ECONOMICS

As with any farm startup, the initial costs required for growing prawns can be substantial; however, many farmers, most likely, will already have numerous items.

Of course, the farmer must have the land, and may have to construct the pond, or perhaps, re-work a present pond. A 1-acre pond can cost up to $5,000 to build. We took $4,500 to be our pond construction cost.

An aerator, water pump, dissolved oxygen or D.O. meter, and a water quality test kit will be required. Some farmers may already have a pickup truck, a riding mower, and a storage shed for prawn feed. Sometimes, holding tanks can be borrowed or rented.

Tracking expenses and time spent in prawn growout are necessary if you are to determine your level of productivity and profit or loss.

Investment Items

Item	Size/Time	Cost
Land	1 acre	$1,040
Pond	1acre/10yr	4,500
Aerator	1hp/3yrs	750
Waterpump	5hp/5yrs	542
D.O. Meter	5yrs	715
Water Qual. Kit	1 yr	179
Pickup	10 yrs	20,000
Riding mower	10 yrs	1,000
Weedeater	5 yrs	200
Storage shed	20 yrs	2,000
Harvest baskets	10 yrs	60
Holding tanks	10 yrs	$400/ tank

The cost of juveniles for stocking will be the largest operating expense.

Operating Expenses/Variable Costs

Once the pond design and preparation are complete, it's time to think about stocking with juveniles. Prices for juveniles vary from 10-12 cents each in Kentucky. So putting in 16,000 juveniles per acre, can cost about $1,600. Feed will cost about $500. The chart shows 32% protein feed, about 100 lbs. per acre.

Other cost items include chemicals, electricity for running the aerator, and gas for the pond pump, truck and mower. A permit is required, and don't forget about maintenance. Also, calculate your cost for use of the telephone.

Harvesting Costs Breakdown

Harvesting costs are an important part of prawn farming. Costs include renting a trailer, obtaining oxygen, ice, packaging materials, and advertisements. Harvesting costs should be about $293.

Total operating expenses for a 1-acre pond - including harvesting costs - should be about $3,095.

Variable Costs (16k/acre)

Item	Quantity	Price	Cost
Juveniles	16,000	0.10ea	$1,600
32% Feed	1.49tons	$342tn	510
Chemicals	1app.	$61	61
Electricity			200
Pumping	1 time	$20	20
Fuel	50 gals	$1.50	75
Legal fees	1 permit	$100	100
Maintenance	1 season	$156	156
Telephone	4 months	$20	80

Harvesting Costs Breakdown

Item	Quantity	Price	Cost
Trailer rent	1 time	$50	50
Oxygen	1 bottle	$17	17
Ice	900 lbs	0.14	126
Packaging			50
Advertisements			50

Total Operating Costs- $3,095

Labor and Management

Labor is a major part of prawn farming. Typically, a farmer spends about 1 to 1 1/2 hours on a single-acre pond everyday in feeding, doing water quality tests, and equipment maintenance -- and also in managing the operation.

The chart estimate is a bit over $1,000 worth of labor for 1 year. However, many farmers provide the labor and management for free and do not consider the labor costs in the accounting expenses.

Non-Cash Costs

Non-cash costs involve equipment depreciation, and interest on real estate and equipment. Annual depreciation considers the costs of the deterioration of your equipment and ponds. Interest and depreciation combined should be between $1500 and $2000.

Labor Requirements

Item	Quantity	Price	Cost
Stocking	2hr/acre	$5.25	$10.50
Feed/Test/ Maintenance	1hr/dyX107dy	X$5.25=	562
Daily Mgt.	1/2hr/dayX107X	$8.00 =	428
Mow/Weed	2hr/wkX15wksX	$5.25=	157.50

Total Labor Costs-$1,158

Non-Cash Costs

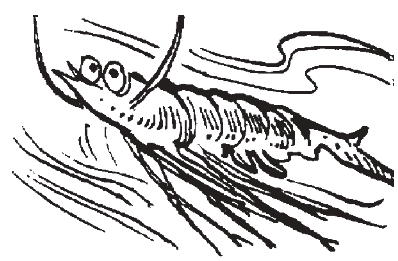
Annual Depreciation = $1,205

Annual Interest = 747

========

Total Non-Cash Costs $1,952

When all costs are added - labor and management are not considered - the total is just over $5,000 for growing 16,000 freshwater prawns in a 1-acre pond.



Calculate your breakeven price in order to determine your profit margin.

Evaluating Breakeven Price

What is a breakdown price? It is the minimum price at which a farmer needs to sell his/her prawns to cover costs.

Figure 36.

Prawn Cycle

- **Broodstock - Oct./April**
- **Hatchery - March**
- **Nursery - April/May**
- **Growout - June/Sept.**

If the total output from a single-acre pond was 800 lbs., the grower must sell the prawns for at least $6.32 per lb. If more than 800 pounds are harvested, then the breakeven price is less. A 1,000-lbs. harvest would take the breakeven price to below $5.06 per pound.

Evaluating Breakeven Price

Total Operating Costs	$3,095
Interest	747
Depreciation	1,205
Property Tax	9
TOTAL COSTS	**$5,056**

Total Yield	Breakeven price= Total Cost / Total Output
800 lbs/acre	**$6.32/ lb selling price**
900 lbs/acre	**$5.62/ lb**
1,000 lbs/acre	**$5.06/ lb**

MARKETING IN KENTUCKY

As many prawn producers have discovered, pond-bank sales are an effective marketing tool. However, many farmers have simultaneously realized that this market is highly limited, primarily because its success is dependent on individual consumers having enough motivation to drive to a farmer's pond on harvest day to buy prawns at $6 to $10 per pound.

Many Kentuckians cannot afford to purchase prawns at these prices, and even if they could afford it, many are unwilling to drive to an unfamiliar farm that could be far from population centers to buy this product.

Although it would be relatively easy for farmers to sell prawns to wholesalers, current wholesale prices ($4.30 /lb to $5.50 /lb) have often made this an unprofitable option. It is imperative for producers to discover wholesale and/or retail markets that will pay $6 to $10 /lb, in order for prawn farming to be profitable. A few individual entrepreneurial farmers have experienced success in selling prawns to specialty restaurants that have clientele that are willing to pay the prices necessary to make prawns profitable for the restaurant. Another possibility for retail sales exists in the many Kentucky festivals that are annually scheduled during the September prawn-harvest season. These festivals often attract thousands of visitors, who are looking to eat something unique.

Figure 37. *The Freedom Freshwater Shrimp Festival in Byrdstown, TN, featured several tents with shrimp prepared for every taste.*

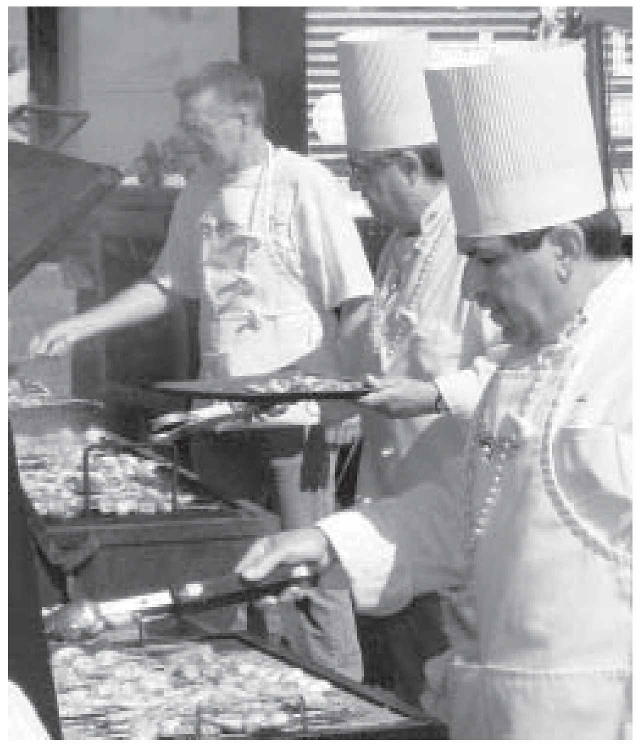


Figure 38. *At the Byrdstown Festival, two chefs from New Orleans used their special marinades before grilling Kentucky and Tennessee freshwater prawns.*

The interest level in prawns can be heightened if prawns are prepared in a variety of methods (e.g., fried, scampi, Cajun-fried and prawn gumbo). Profit can be enhanced by preparing prawn dishes that contain a few prawns and many inexpensive side items such as rolls, fries, Cajun rice, and vegetables.

Consider joining with other growers in your area to sponsor a shrimp festival in September.

Renting a food booth can cost as little as $100 per weekend and potential customers can be attracted by displaying aquariums of live prawns and other Kentucky aquaculture species. Festival organizers often welcome participation of producers if they can provide an educational experience, in conjunction with food. An aquarium, pamphlets and a video presentation about prawn farming in Kentucky are several educational outlets that help consumers understand that freshwater prawns are an exotic species that is cultured under a quality-controlled environment. Information on the timing, location and contact people for Kentucky's annual festivals are available online (www.tourky.com/tourky/festivalsevents.htm).

Small males are a marketing problem for pond-bank sales because customers are unwilling to pay in excess of $6 /lb for stunted prawns.

Selling small males can be hazardous in retail markets that are hinged on product size, quality and good producer reputation. Selling small males as bait at Kentucky's bait shops may provide a viable marketing option. A list of Kentucky's pay lakes and bait shops appears in the Kentucky Aquaculture Directory published by the Kentucky Department of Agriculture (www.kyagr.com). Other options include using tail meat of small males to produce value-added products such as prawn Beignette, which is a mixture of prawn and hushpuppy batter, fried and sold as finger food. This is similar to "crawfish poppers" produced with sub-market crawfish meat in Louisiana. However, developing these products will require government-approved processing facilities and marketing ingenuity.

QUESTIONS

If you have additional questions about the growing of prawns, contact your local Extension Agent or Kentucky State University's Aquaculture Research Center.

KSU Aquaculture Research Center
103 Athletic Road
Frankfort, KY 40601
502.597.8103
www.ksuaquaculture.org

D.O. Chart (Plot points twice daily: early morning and late afternoon.)

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Table 4.

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pH Chart (Check pH everyday at mid-afternoon and plot on graph.)

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Table 5.
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Notes

Equipment Vendors

This list of vendors is provided as a courtesy to readers, and does not necessarily imply a recommendation of the companies.

Aqua Eco-Systems, Inc.
Toll-Free: 877.FISH.STUF
Fax: 407.886.6787
E-mail: aes@aquaticeco.com
Web: www.aquaticeco.com
1767 Benbow Court
Apopka, FL 32703

Aquacenter, Inc.
Toll-Free: 800.748.8921
Fax: 662.378.2862
Tech Assistance: 662.378.2861
166 Seven Oaks Rd.
Leland, MS 38756

Area, Inc.
Phone: 305.248.4205
Fax: 305.248.1756
E-mail: areainc@aol.com
Web: www.areainc.com
P.O. Box 901303
Homestead, FL 33090-1303

Eagar, Inc.
Toll-Free: 800.423.6249
Phone: 801.292.9017
Fax: 801.295.7569
P.O. Box 540476
N. Salt Lake, UT 84054

Southern Aquaculture Supply, Inc
Toll-Free: 800.850.7274
Fax: 870.265.4146
E-mail: sales@southernaquaculturesupply.com
Web: www.southernaquaculturesupply.com
P.O. Box 326
Lake Village, AR 71653

KSU Land Grant
Aquaculture Research Center
103 Athletic Road
Frankfort, KY 40601
502.597.8103 **www.ksuaquaculture.org**

Listing of Suppliers of Freshwater Prawn Postlarvae & Juveniles

Postlarvae & Juveniles

Aquaculture of Texas, Inc
Attn: Craig Upstrom
4141 Fort Worth Highway
Weatherford, TX 76087-8610
817.594.4872

Thoroughbred Shrimp Co.
8715 U.S. 421 N.
Frankfort, KY 40601
502.875.2461

Lauren Farms
Attn: Dolores & Steve Fratesi
655 Napanee Road
Leland, MS 38756
662.686.2894

Juveniles Only

Bluegrass Shrimp & Fish Co.
Attn: Steve Price
4425 Ernst Bridge Road
Covington, KY 41015
859.371.2583

Freedom Freshwater Shrimp Co.
Attn: Dan Cook or Doug Elder
P.O. Box 39
Byrdstown, TN 38549
931.864.3005

Gregnon Farm, Inc.
4780 Paris Pike
Mt. Sterling, KY 40353
859.498.1698

(This listing of suppliers is provided as a courtesy and does not necessarily imply a recomendation of these companies.)

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