SRAC Publication No. 484

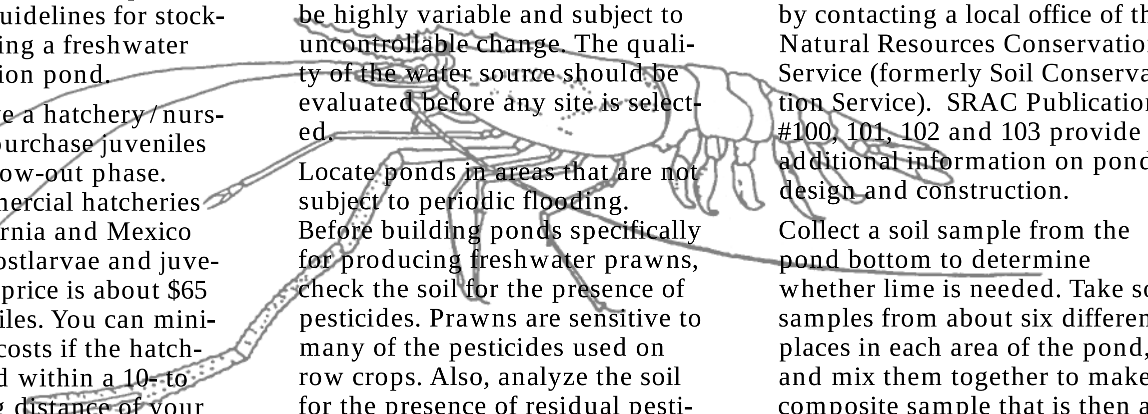
Southern
Regional
Aquaculture
Center

July 1996

Production of Freshwater Prawns in Ponds

Louis R. D'Abramo and Martin W. Brunson*

The final phase of freshwater prawn (shrimp) production is grow-out of juveniles to adults for market as a food product. Research in Mississippi, Kentucky and other southern states has demonstrated this can be a profitable enterprise, and this publication provides guidelines for stocking and managing a freshwater prawn production pond.



Unless you have a hatchery/nursery, you must purchase juveniles for the pond grow-out phase. There are commercial hatcheries in Texas, California and Mexico that produce postlarvae and juveniles. The 1996 price is about $65 per 1,000 juveniles. You can minimize shipping costs if the hatcheries are located within a 10- to 14-hour driving distance of your grow-out facility. Otherwise, it is best to have the juveniles shipped via plane, but this significantly increases the cost.

Site selection and pond design

Ponds used for raising freshwater prawns should have many of the same basic features of ponds used for the culture of channel catfish. A good supply of freshwater is important, and the soil must have excellent water-retention qualities. Well water of acceptable quality is the preferred water source for raising freshwater prawns. Surface runoff water from rivers, streams and reservoirs can be used, but quality and quantity can be highly variable and subject to uncontrollable change. The quality of the water source should be evaluated before any site is selected.

Locate ponds in areas that are not subject to periodic flooding. Before building ponds specifically for producing freshwater prawns, check the soil for the presence of pesticides. Prawns are sensitive to many of the pesticides used on row crops. Also, analyze the soil for the presence of residual pesticides. Do not use ponds that are subject to drift from agricultural sprays or to runoff water that might contain pesticides.

The surface area of grow-out ponds ideally should range from 1 to 5 acres, but larger ponds have been successfully used. The pond should be rectangular in shape to facilitate distribution of feed across the entire surface area. The bottom of the pond should be completely smooth and free of any potential obstructions to seining. Ponds should have a minimum depth of 2 to 3 feet at the shallow end and a maximum depth of 3.5 to 5 feet at the deep end. The slope of the bottom should allow for rapid draining. You can obtain assistance in designing and laying out ponds by contacting a local office of the Natural Resources Conservation Service (formerly Soil Conservation Service). SRAC Publications #100, 101, 102 and 103 provide additional information on pond design and construction.

Collect a soil sample from the pond bottom to determine whether lime is needed. Take soil samples from about six different places in each area of the pond, and mix them together to make a composite sample that is then air-dried. Put the sample in a soil sample box, available from your county Extension agent, and send it to the state soil testing laboratory in your state, typically operated by the Cooperative Extension Service, and request a lime requirement test for a pond. There may be a small charge for this service. If the pH of the soil is less than 6.5, you must add agricultural limestone to increase the pH to a minimum of 6.5, and preferably 6.8.

*Mississippi State University

After filling the pond, fertilize the pond to provide an abundance of natural food organisms for the prawns and to shade out unwanted aquatic weeds. Liquid fertilizer, either a 10-34-0 or 13-38-0, or one of the highly water soluble powders (12-49-6 or 10-52-0) give excellent results. Apply 1/2 to 1 gallon of liquid fertilizer or 4 to 6 pounds water soluble powder per surface acre to the pond at least 1 to 2 weeks before stocking juvenile prawns. If a phytoplankton bloom has not developed within a week, either make a second application of the fertilizer, or add water from an adjacent pond that has an adequate bloom to seed the bloom in the prawn pond. Do not apply liquid fertilizer directly into the water because it is denser than water and will sink to the bottom; liquid fertilizer should be diluted with water 10:1 before application. It can be sprayed from the bank or applied from a boat distributed in the propwash of an outboard motor. The water soluble powders can be applied directly to the water surface, or distributed with a boat or via currents created by a paddlewheel aerator.

If a water source other than well water is used, it is critically important to prevent fish, particularly members of the sunfish family (e.g., bass, bluegills and green sunfish) from getting into the pond when it is filled. Screening or filtering the incoming water is highly advisable. The effects of predation on freshwater prawns by these kinds of fish can be devastating. If there are fish in the pond, remove them before stocking prawns, using 1 quart of 5 percent liquid emulsifiable rotenone per acre-foot of water when water temperatures exceed 70ºF. Rotenone is a restricted use pesticide, and either a commercial or private pesticide applicators license is required to purchase and apply this material. Assistance in obtaining this license or certification can be obtained through your county Extension office.

Stocking of juveniles

Juvenile prawns must be gradually acclimated to conditions in the grow-out pond to prevent temperature shock or other types of stress. Water in which postlarvae and juveniles are transported should be gradually replaced by the water in which they will be stocked. This acclimation procedure should not be attempted until the temperature difference between the transport and culture water is less than 6 to 10°F. The temperature of the pond water at stocking should be consistently at least 68°F (20°C) to avoid stress because of low temperatures. Juvenile prawns appear to be more susceptible than adults to low water temperatures.

Juveniles, preferably derived from populations that have been size-graded, ranging in weight from 0.1 to 0.3g, should be stocked at densities of 12,000 to 16,000 per acre. The size grading results in more uniform growth and helps to reduce the percentage of smaller, non-marketable individuals at harvest. Lower stocking densities will yield larger prawns but lower total harvested poundage. The density selected should be determined by the particular market that is targeted. For example, if the market demands whole, live or fresh ice-packed prawn, stocking at lower densities will result in larger, more marketable individuals. The duration of the grow-out period depends on the water temperature of the ponds, and the time generally is 120 to 180 days in the southern U.S. Prawns could be grown year-round if a water source is found that provides a sufficiently warm temperature for growth.

Feeding

Juvenile prawns stocked into grow-out ponds initially are able to obtain sufficient nutrition from natural pond organisms. At the recommended stocking densities, begin feeding when the average weight of the prawn is 5.0g or greater. Commercially available sinking channel catfish feed (28 to 32 percent crude protein) is an effective and economical feed at the recommended stocking densities. The feeding rate is based upon the mean weight of the population (Table 1). A feeding schedule can be developed based upon three factors:

1. A feed conversion ratio of 2.5;
2. One percent mortality in the population per week; and
3. Mean individual weight determined from samples obtained every 3 weeks.

At the end of the grow-out season, survival may range from 60 to 85 percent, if you have practiced good water quality maintenance. Yields typically range from 600 to 1,200 pounds per acre. Weights of prawns range from 35 to 45g (13 to 10 per pound). These yields and average sizes, however, will be significantly influenced by initial stocking density.

Water quality management

Water quality is just as important in raising freshwater prawns as it is in raising catfish or any other species of aquatic animal. Dissolved oxygen (DO) is particularly

Table 1. Weight-dependent feeding rates for semi-intensive pond grow-out of *Macrobrachium rosenbergii*.

Mean wet weight (g)	Daily feeding rate (% of body weight)[a]
<5	0
5 to 15	7
15 to 25	5
>25	3

*As-fed weight of diet/wet biomass of prawns x 100.

important, and a good oxygen monitoring program is necessary to achieve maximum yields. You should routinely check and monitor dissolved oxygen in the bottom 1 foot of the pond which the prawns occupy. Electronic oxygen meters are best for this purpose but are rather expensive and require careful maintenance to ensure good operating condition. The need for an electronic oxygen meter increases as the quantity of ponds to be managed increases. With only one or two small ponds, a chemical oxygen test kit is sufficient. Chemical oxygen tests kits that perform 100 tests are commercially available from several manufacturers.

Use a sampler for collecting samples from an appropriate water depth for dissolved oxygen analysis. These sampling devices are commercially available or can be fashioned. It is important the dissolved oxygen concentration in the bottom 1 foot of water does not fall below 3 parts per million (ppm). Dissolved oxygen concentrations of 3 ppm are stressful, and lower concentrations can be lethal. Chronically low levels of dissolved oxygen result in less than anticipated yields at the end of the growing season. Emergency aeration can be achieved by an aerator. The design and size of the aerator depend on the size and shape of the culture pond, but a good rule of thumb is to have available 1 HP of aerator per surface acre of pond.

Prevention of thermal stratification is important, since prawns are bottom dwellers, and stratification results in two potential problems. First, since the bottom layer is cool, prawn growth can be severely retarded. Secondly, these bottom layers often become anoxic, and stress or mortality of the prawns can result. If ponds do not exceed the recommended depth, and aeration is properly employed, thermal stratification is unlikely.

Oxygen depletions can be avoided. An increasingly popular method is to employ either full-time or nightly aeration. Since standing crop biomass seldom exceeds 1,000 lb / acre, this effectively prevents oxygen depletions. Another reliable method to predict low DO levels is to plot the level an hour after sunset and approximately 2 hours later. Plot these two readings on a piece of graph paper and connect them with a straight line (Figures 1 and 2). Oxygen consumption during the late evening and early morning proceeds at a constant rate, caused by the respiration of the animals and plants in the water. By extending the line from these two points over time you can quickly determine if the dawn DO concentration will decrease to the 3 ppm concentration that will stress or possibly kill the prawns. This method indicates whether emergency aeration is necessary and when to provide it. Additional information of pond aeration is available in SRAC Publications # 370, *Pond Aeration*, and 371, *Types and Uses of Aeration Equipment*.

Specific information on water quality requirements of freshwater prawns is limited. Although freshwater prawns have been successfully raised in soft water (5 to

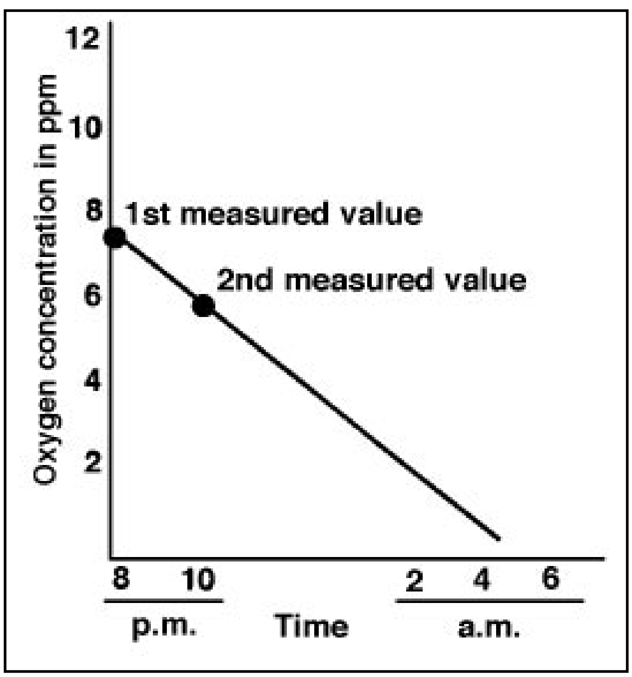


Figure 1. Graphic method of predicting nighttime oxygen depletions in ponds. In this example it is predicted the oxygen concentration will drop to 2 ppm by 2:40 a.m., indicating emergency aeration should be started by 3:30 a.m.

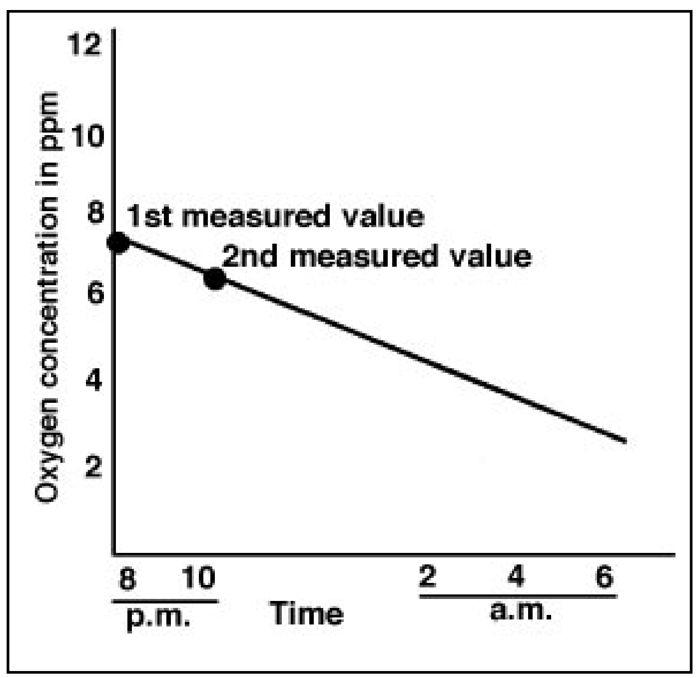


Figure 2. Graphic method of predicting nighttime oxygen depletions in ponds. In this example it is predicted that no oxygen problem will develop in the pond during the night.

7 ppm total hardness) in South Carolina, a softening of the shell was noticed. Hard water, 300-plus ppm, has been implicated in reduced growth and lime encrustations on freshwater prawns. Therefore, use of water with a hardness of 300-plus ppm is not recommended.

Nitrogen compounds

Nitrites at concentrations of 1.8 ppm have caused problems in hatcheries but there is no definitive information as to the toxicity of nitrite to prawns in pond situations. High nitrite concentrations in ponds would not be expected given the anticipated biomass of prawns at harvest. High levels of un-ionized ammonia, above 0.1 ppm, in fish ponds can be detrimental. Concentrations of un-ionized ammonia as low as 0.26 ppm at a pH of 6.83 have been reported to kill 50 percent of the prawns in a population in 144 hours. Therefore, you must make every effort to prevent concentrations of 0.1 or higher ppm un-ionized ammonia. For more information on ammonia and nitrites in fish ponds, request SRAC Publications # 462, *Nitrite in Fish Ponds*, and #463, *Ammonia in Fish Ponds*.

Acceptable pH ranges

A high pH can cause mortality through direct pH toxicity, and indirectly because a higher percentage of the total ammonia in the water exists in the toxic, un-ionized form. Although freshwater prawns have been raised in ponds with a pH range of 6.0 to 10.5 with no apparent short-term adverse effects, it is best to avoid a pH below 6.5 or above 9.5, if possible. Constantly high pH stresses the prawns and reduces growth rates. High pH values usually occur in waters with total alkalinity of 50 or less ppm and when a dense algae bloom is present. Before stocking, liming ponds that are built in acid soils can help minimize severe pH fluctuations.

Another way to manage to avoid any anticipated problems of high pH is to reduce the quantity of algae in the pond by periodic flushing (removing) the top 12 inches of surface water. Alternatively, organic matter, such as corn grain or rice bran, can be distributed over the surface area of the pond. This procedure must be accompanied by careful monitoring of oxygen levels, which may dramatically decrease due to decay processes.

Diseases

Diseases so far do not appear to be a significant problem in the production of freshwater prawns, but, as densities are increased to improve production, disease problems are bound to become more prevalent. One disease you may encounter is “blackspot” or “shell disease,” which is caused by bacteria that break down the outer skeleton. Usually it follows physical damage and can be avoided by careful handling. At other times, algae or insect eggs may be present on the shell. This condition is not a disease, but rather an indication of slow growth, and is eliminated when the prawn molts.

Harvesting

At the end of the grow-out season, prawns may be seine- or drain-harvested. For seining, depth (or water volume) should be decreased by one-half before seining. Alternatively, ponds could be drained into an interior large rectangular borrow pit (ditch) where prawns are concentrated before seining. You can effectively drain harvest only if ponds have a smooth bottom and a slope that will insure rapid and complete draining. During the complete drain-down harvest procedure, prawns generally are collected on the outside of the pond levee as they travel through the drain pipe into a collecting device. To avoid stress and possible mortality, provide sufficient aeration to the water in the collection device.

Selective harvest of large prawns during a period of 4 to 6 weeks before final harvest is recommended to increase total production in the pond. Selective harvesting usually is performed with a 1- to 2-inch bar-mesh seine, allowing those that pass through the seine to remain in the pond and to continue to grow, while the larger prawns are removed. Selective harvest may also be accomplished with properly designed traps. Prawns can be trapped using an array of traditionally designed crawfish traps. Selective harvest can help to extend the duration of the availability of the fresh or live prawn product to the market. However, there is a lack of research to show whether selective harvesting or a complete bulk harvest is the most economical approach.

Regardless of the harvest method employed, some prawns will remain in the bottom of the pond and will have to be manually picked up. Rapid draining or careful seining can minimize this residual crop left in the pond.

Prawns should be quickly chilled after harvest to preserve integrity of the muscle tissue, thus maintaining a firm, high quality texture to the product. The product may be marketed fresh on ice, or may be either processed and frozen or frozen whole for storage and shipment.

Polyculture and intercropping

Culture of freshwater prawns in combination with fingerling catfish has been successfully demonstrated under small-scale, experimental conditions, and appears possible under commercial conditions. Before introduction of catfish fry, stock juvenile prawns at a rate of 3,000 to 5,000 per acre. Stock catfish fry at a density to insure that they will pass through a 1-inch-mesh seine used to harvest the prawns at the end of the growing season. Although polyculture of prawns and a mixed population of channel catfish has been successfully demonstrated, logistical problems arising from efficient separation of the two crops is inherent in this management practice. Moreover, when harvest of prawns is imminent due to cold water temperatures, catfish may not be a harvestable crop due to an "off flavor" characteristic. Polyculture of channel catfish and freshwater prawns may be best achieved through cage culture of the fish.

Recently, a scheme for intercropping of freshwater prawns and red swamp crawfish was developed and evaluated (Figure 3). Intercropping is the culture of two species that are stocked at different times of the year with little, if any, overlap of their growth and harvest seasons. Intercropping provides for a number of benefits that include:

1. Minimizing competition for resources;
2. Avoiding potential problems of species separation during or after harvest; and
3. Spreading fixed costs of a production unit (pond) throughout the calendar year.

Adult mature crawfish are stocked at a rate of 3,600 per acre in late June or early July. Juvenile prawns are stocked at a density of 16,000 per acre in late May and harvested from August through early October. In late February, seine harvest of the crawfish begins and continues through late June before stocking of new adult crawfish. Prawns are small enough to pass through the mesh of the seine used to harvest crawfish during the May-June overlap period. Other intercropping scenarios involving such species as bait minnows, tilapia and other fish species may be possible, but to date no research has been conducted in the Southeast.

Processing and marketing

Production levels and harvesting practices should match marketing strategies. Without this approach, financial loss due to lack of adequate storage (holding) facilities or price change is inevitable. Marketing studies strongly suggest that a "heads off" product should be avoided and that a specific market niche for whole freshwater prawns needs to be identified and carefully developed.

To establish year-round distribution of this seasonal product, freezing, preferably individually quick frozen (IQF), is an attractive form of processing, and recent research has demonstrated its efficacy and potential. Block frozen is an alternative method of processing for long-term distribution. Recent research at the Mississippi Agriculture and Forestry Experiment Station suggests that adult freshwater prawns can be successfully live hauled for at least 24 hours, at a density of 0.5 pound per gallon, with little mortality and no observed effect on exterior quality of the product. Transport under these conditions requires good aeration. Distribution of prawns on "shelves" stacked vertically within the water column assists in avoiding mortality due to crowding and localized poor water quality. Use of holding water with a comparatively cool temperature (68 to 72°F) minimized incidence of water quality problems and injury by reducing the activity level of the prawns.

Economic feasibility

Based on an average feed cost of $250 to $300 per ton, a seedstock cost of $65 per 1,000 juveniles, a 2.5 to 1 feed conversion, expected mean yields of 1,000 pounds per acre, and a pond bank selling price of $4.25 per pound, the expected return can be as high as $2,000 to $2,500 per acre. Revenue and ultimate profitability depend on the type of market that is used. This estimated return does not include labor costs or other variable costs that differ greatly from operation to operation. Some thorough economic evaluations that incorporate annual ownership and operating costs under different scenarios for a synthesized firm of 43 acres, having 10.25 acres of water surface in production, are provided in Mississippi Agriculture and Forestry Experiment Station Bulletin 985, available from the Department of Agricultural Economics, Mississippi State University.

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Prawns	year 1					Stock				Harvest			
	year 2					Stock				Harvest			
Crawfish	year 1								Stock				
	year 2		Harvest						Stock				

Figure 3. A 24-month stocking and harvest scheme for intercropping freshwater prawns and crawfish. All years following year 2 will be the same as year 2.

The work reported in this publication was supported in part by the Southern Regional Aquaculture Center through Grant No. 89-38500-4516 from the United States Department of Agriculture.