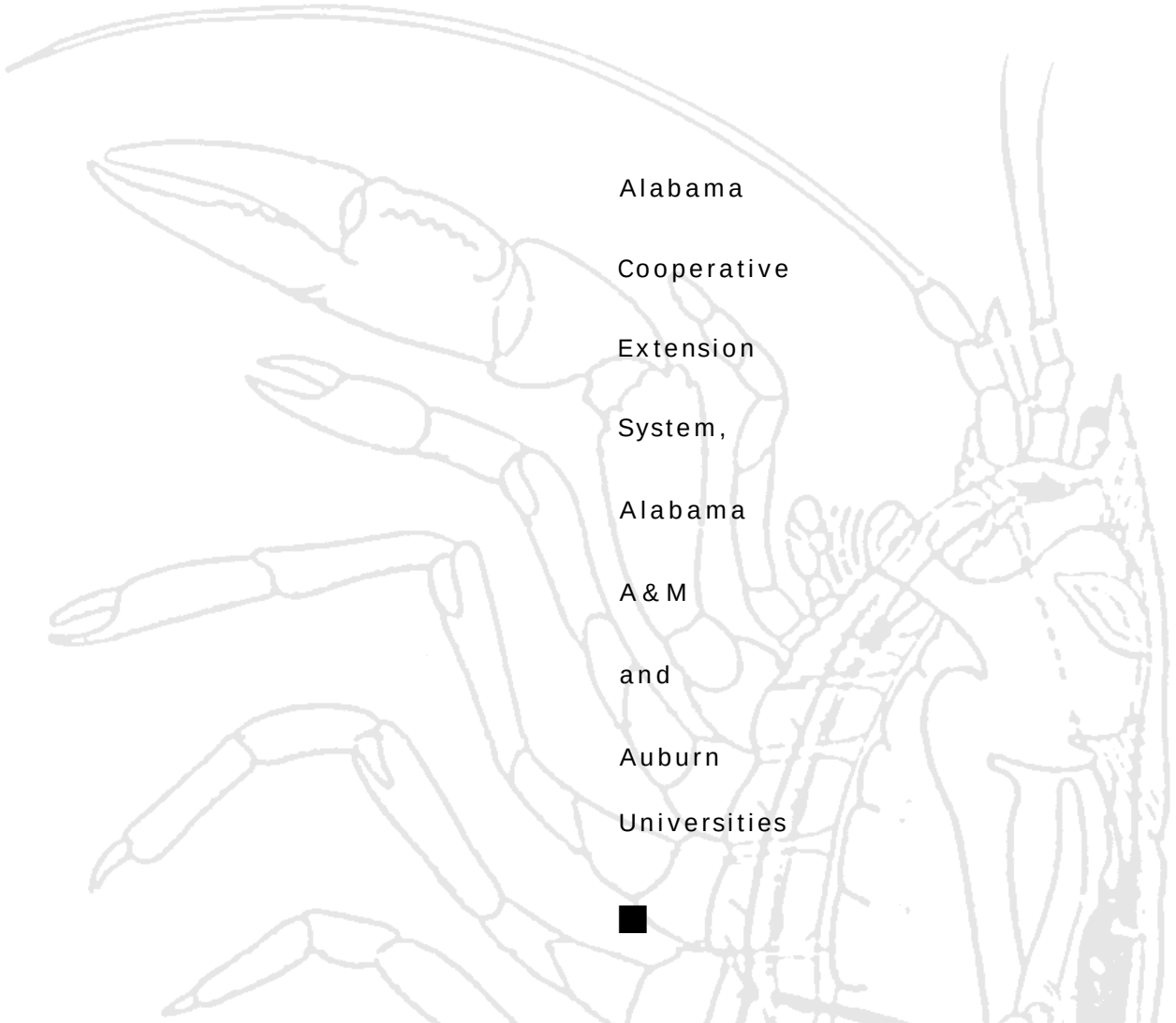

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Production Of Crawfish In Alabama

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Production Of Crawfish In Alabama

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Crayfish are considered a delicacy in many parts of the world. In the United States, Louisiana is famous for its Cajun cuisine of which crayfish or "crawfish" is a traditional element. Outside Louisiana and a few other southeastern states, crawfish are generally hard to find in the marketplace, and most people do not know how to cook them. However, once people have sampled these delicious crustaceans, they usually want more.

Surveys suggest that many markets exist for crawfish that are not being met by the current supply. Crawfish farming has just begun in Alabama, but markets have already been identified that cannot be satisfied at current production levels. Crawfish production may be an alternative enterprise that can increase income on some Alabama farms.

Crawfish aquaculture is an off-season farming enterprise, because most of the labor is required during winter and early spring when demands from other farming activities are not as high. Additionally, marginal agricultural lands can often be converted to crawfish ponds.

Like other types of aquaculture, crawfish production is not a "get rich quick" scheme. A venture into crawfish aquaculture demands the necessary resources, detailed plans, and sound marketing strategies. This publication will address these issues as they pertain to crawfish production in Alabama. The information provided comes from research conducted mostly in Louisiana and from the experience of producers who have pioneered crawfish production in Alabama.

Pond Construction

The first step in crawfish farming is to determine if you have a suitable site for building crawfish ponds. Crawfish ponds demand:

- Relatively flat land (less than 3 percent slope).
- Soil with a high clay content.
- A good water source.

Crawfish ponds are flat-bottomed, levee-type ponds in which soil is removed from the center of the pond to form two to four surrounding dams or levees. Water depth in crawfish ponds should be only 18 to 24 inches. The pond bottoms ideally should slope less than 6 inches from the shallowest to the deepest part of the pond. A drain must be installed in the deepest part of the pond. The drain must be designed to allow the water level to be regulated and of sufficient size to allow for complete draining over a period of 2 weeks. The outer levees must be cored with high quality clay and have a minimum base width of 9 feet and a freeboard (levee above water level) of 12 inches.

The clay content of the soil is extremely important in crawfish ponds. The soil should be that of a tight clay that will allow the crawfish to dig deep burrows that will not collapse when flooded. Many clay soils suitable for general pond construction are not deep enough or tight enough for crawfish ponds. **Burrowing is crucial for crawfish reproduction and burrows must not collapse when flooded.**

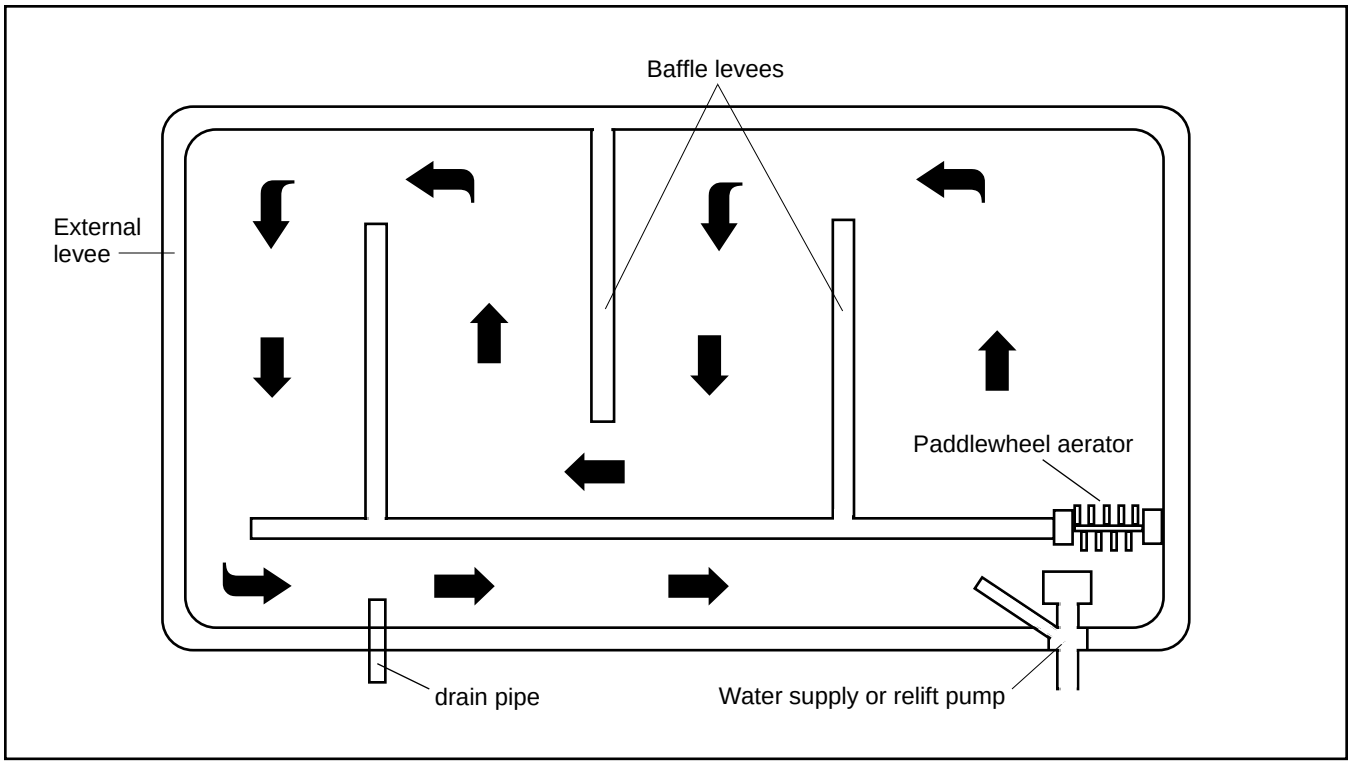


Figure 1. System of baffle levees to direct water movement and location of pumps or aerators.

The newest design for large crawfish ponds utilizes cross or baffle levees (Figure 1) to direct water movement during pumping or aeration. This design is used most often in ponds larger than 5 acres. Regardless of the size of the pond, some aeration or water exchange will be necessary to maintain water quality during the production cycle.

For assistance in site selection and pond design, contact the USDA Soil Conservation Service (SCS) office in your county. In west Alabama contact the Alabama Fish Farming Center in Greensboro.

Water

Another essential resource for crawfish production is an abundant supply of good quality water. Crawfish ponds must be filled or flushed with water in a relatively short period of time during "flood-up" (fall pond filling) or when water quality deteriorates. Generally, a crawfish pond will need a water source supplying at least 70 gallons per acre per minute. Either well water or surface water is suitable for crawfish ponds. Ground water from wells should be aerated as it enters the pond to increase its dissolved oxygen concentration, remove excess carbon dioxide and hydrogen sulfide, and precipitate excess iron. Surface water from ponds, rivers, or streams can be used to fill crawfish ponds but should be aerated and carefully filtered or screened to remove any fish or their eggs. Even very small fish are successful predators on young crawfish.

Most crawfish ponds in Alabama will need be to limed. Soils outside of the Blackbelt Prairie and a few in the Tennessee Valley are acidic. Crawfish do best in soils with a pH of at least 6.5 and in water with a total alkalinity of 50 mg/l or greater. Soil tests should be conducted on the pond soils to determine the amount of lime to be added. Several tons per acre may be needed to correct many of Alabama's soils. Ponds are easiest to lime before they are filled with water by spreading finely ground calcitic or dolomitic limestone over the entire pond bottom.

Crawfish must have near 100 percent humidity in their burrows to keep their gills damp and for the female to keep her eggs (attached to her abdomen) moist. Ponds should be constructed in areas that have a naturally high water table, or ponds can be periodically irrigated with water to maintain soil moisture.

Natural History Of Crawfish

There are more than two dozen species of crawfish in the southeastern United States. The principle species cultured is the red swamp crawfish *(Procambarus clarkii)*. The white river crawfish *(P. zonangulus)* is also commonly found throughout the Southeast and will usually become residents of crawfish production ponds. The two species are harvested and marketed together, but red swamp crawfish have characteristics that make them superior for culture. The following natural history is based on the

Spawned, fertilized eggs attached to the female's abdomen.

red swamp crawfish, but many of the characteristics are also true of other species of crawfish.

Adult crawfish mate in open water throughout the year. Peak months of mating occur in May and June, typically when temperatures are between 70° and 80°F. Females can store sperm from the males for as long as 8 months before using it to fertilize their eggs (spawns). The female burrows into the soil (usually above water level) after mating. The natural habitat of crawfish is wetlands that dry up in the summer. Mating and burrowing corresponds with the dry cycle of these wetlands. Burrows are dug to the water table and can extend several feet below the surface. The burrow is kept moist with a cap of soil called a "chimney." A male will in most cases occupy the burrow with the female.

Egg development within the female crawfish takes place over a period of 2 to 5 months, depending on temperature. While in the burrow, the eggs mature and are released (spawned). The eggs are fertilized from stored sperm and attached to the swimmerettes beneath the females abdomen (Photo at left and Figure 2). A single female can produce 100 to 700 eggs (average 300), depending on her size. The female keeps the eggs moist by dipping them into the water trapped in the burrow. Eggs hatch usually in 2 to 3 weeks but may take as long as 4 months at low temperatures.

Newly hatched crawfish grow rapidly and reach harvestable size in 2 to 5 months, depending on water temperature. The normal life span of the red swamp crawfish is usually about 1 year but not more than 2 or 3 years.

The Production Cycle

Crawfish aquaculture imitates the natural life cycle of the crawfish as described above. Crawfish ponds are drained ("drawn-down") in the late spring to encourage mature crawfish to mate and burrow. A forage crop is planted in the dry pond while the crawfish are in their burrows with their eggs developing. The pond is re-flooded in the early fall when young-of-the-year crawfish have hatched and are ready to start foraging. Young crawfish forage on the decaying vegetation and reach a harvestable size by early spring. While peak spawning activity occurs in the spring, some spawning occurs in the fall and winter. This results in several sizes or groups of young crawfish developing throughout the spring. The cycle starts again when the food supply is exhausted, temperatures are rising rapidly, and eggs within the females begin to mature.

In order to grow, crawfish "molt" by shedding their exoskeleton (their "shell") and producing a new

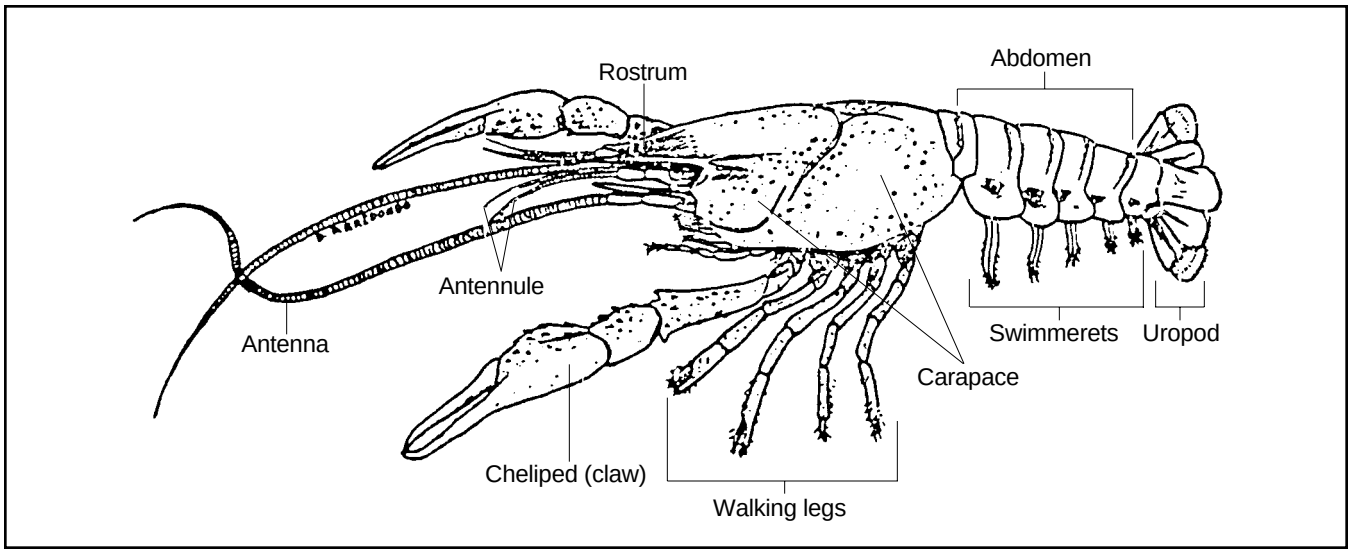


Figure 2. Major parts of a female crawfish.

one. A crawfish nearly doubles its size with each molt. Most crawfish growth occurs at temperatures between 60° and 86°F. Given adequate food, proper temperatures, and good water quality, a newly hatched crawfish can reach marketable size in 90 to 120 days.

Stocking

Newly built crawfish ponds should be filled with a foot or more of water and allowed to stand for 10 to 14 days before brood crawfish are introduced into the pond. This period of time allows the pond temperature to stabilize and the existing vegetation to decay. Decay of existing vegetation can cause oxygen depletions. Crawfish should not be stocked until vegetation has decayed to the point that an oxygen depletion is unlikely. The early morning dissolved oxygen concentrations should be above 2.5 mg/l. Oxygen concentrations can be checked with inexpensive chemical test kits or an electronic oxygen meter.

Brood crawfish should be acquired from an established crawfish production pond and stocked into new ponds in April or May. Newly captured or trapped crawfish should be moved to the new pond as quickly as possible (see Transporting And Storage, page 10). It is best to stock crawfish within 2 to 3 hours after they have been trapped. Crawfish that have been stored in a cooler or on ice should not be used. Crawfish should be stocked into new ponds at 40 to 60 pounds per surface acre and should be at least a 30 count in size (30 per pound). Brood crawfish should be:

- Predominately the red swamp species.
- About equal in numbers of males and females (1:1).
- Composed of 20 percent or more of females having tan to brown eggs in their ovaries.

The simplest way to distinguish red swamp crawfish from white river crawfish is to examine the grooves (lines) on the head or carapace (Figure 3, a). Grooves on the head run together or form one groove in the red swamp but are separate in the white river crawfish. Females and males can be distinguished by the first pair of swimmerettes under the abdomen (Figure 3, b). The first pair of swimmerettes of males are larger and are hardened into tubes for transferring sperm during mating. Females can be examined for egg development by removing the abdomen and examining the ovaries located near the head region. Eggs in the ovaries change color as they mature from pale white to yellow, orange, tan, and, finally, to dark brown.

Females with orange, tan, or brown eggs in their ovaries will produce several groups of young-of-the-year juveniles in the fall which will be harvestable from December through March. Females with ovaries that are white to yellow will re-burrow a month or two after fall flood-up. Offspring from these later maturing females will grow to harvestable sizes by April or May, depending on water temperature and water quality.

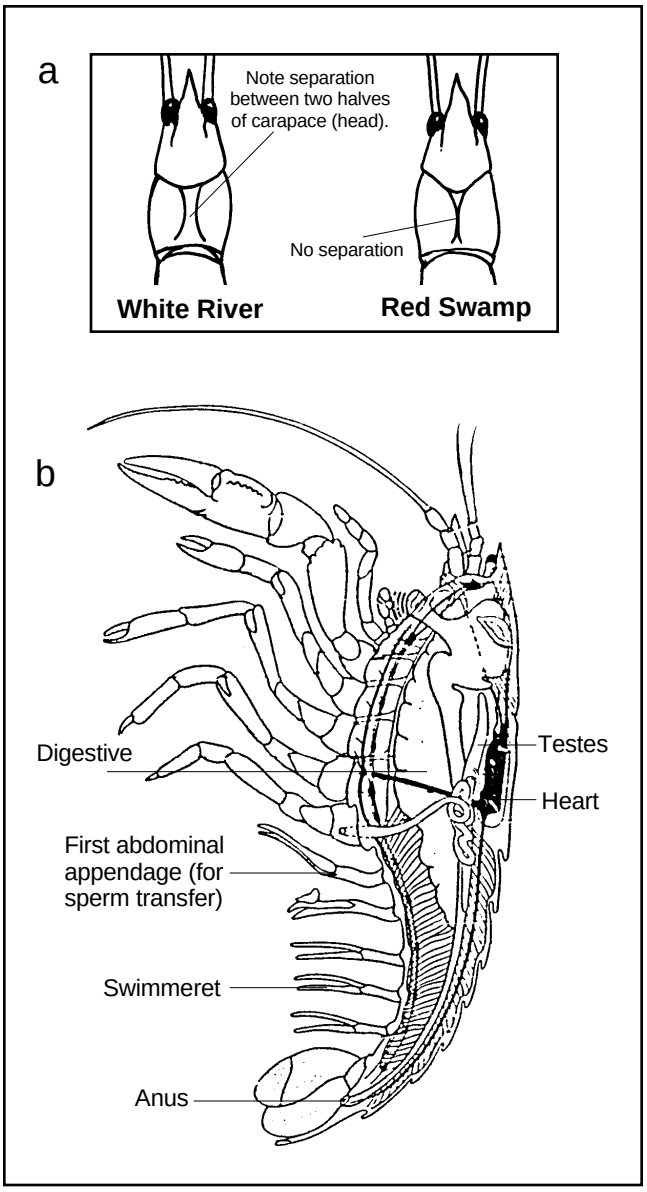


Figure 3. (a) Groove lines on head run together on red swamp crawfish (right) but are separate on white river crawfish (left). (b) Male crawfish showing first pair of swimmerets. Compare to female anatomy, Figure 2.

Stock crawfish by placing the sack at the edge of the pond. Splash pond water over the crawfish for 2 to 3 minutes to adjust them to the water temperature. Walk along the pond levees and slowly pour the crawfish into the water, trying to distribute them evenly throughout the pond.

Allow the crawfish at least a week to adjust to the pond before starting the draw-down process. If no natural forage is available, sinking catfish feed (15 to 30 pounds per acre), cottonseed meal, or flakes of hay can be added to the pond.

Generally, it is not necessary to restock a crawfish pond in subsequent years once it is established.

Draw-down

Crawfish ponds should be drained in late May or June. If crawfish in the pond appear small or immature, draining ponds later in June will allow more crawfish to mature. However, 95°F is the upper lethal temperature for crawfish and if pond water reaches this temperature some mortality will occur.

Draining the pond must be done over a 10- to 14-day period by dropping the water only 1 to 1½ inches per day. The gradual draw-down stimulates the crawfish to burrow. Crawfish will typically burrow first along the levees. Burrowing can be encouraged by placing cardboard, small hay bales, or other substrate along the levees for them to burrow under. **Not all crawfish will burrow.** Do not be concerned if many crawfish do not burrow, because there still will be enough that do burrow to assure next year's crop.

Forage

Forage crops that have been used in crawfish culture include rice or sorghum sudan. Rice, because of its semi-aquatic nature, causes less water quality deterioration and is the most commonly used forage for crawfish production. Rice for crawfish forage (not for rice production) is usually planted from mid-July through early August. The Mars variety of rice appears to be best suited for crawfish production. Establishing a stand of rice during hot summer temperatures can be difficult.

Rice can be cultivated in a dry seedbed like other grain crops, and the seed can be drilled or broadcast. Adequate forage can be established at seeding rates of 75 to 90 pounds per acre. If the dry broadcast method is used, it is best to cover the seed using a harrow. Rice seed will need moisture within 3 or 4 days to germinate. If rain does not closely follow planting, it will be necessary to irrigate or flood the pond (then immediately drain it to avoid "scalding" the germinating rice seed). Periodic irrigation will be necessary if timely rains do not occur. **Rice does not tolerate dry conditions.**

Rice should be fertilized to assure good forage production. A soil test is the best method to determine the proper fertilizer grade and application rate. Applying 60 to 80 pounds (per acre) of nitrogen (N) and 30 pounds of both phosphorous (P) and potassium (K) are usually adequate for good rice production.

Sorghum sudan grass has been used successfully as a forage for crawfish. Sorghum sudan should be planted from mid-August through early September. Sorghum sudan should not be planted earlier than mid-August or it will produce so much vegetation that the crawfish pond will be difficult to harvest and may suffer from rapid decomposition and resulting low oxygen. Likewise it should not be planted later than early September or it will not have suitable conditions for good growth.

Sorghum sudan should be seeded at the rate of 25 to 30 pounds per acre. Drilling is the preferred method of planting. Adequate soil moisture is necessary for proper establishment but once established, sorghum sudan is relatively tolerant of drought.

It may be desirable to cut or mow trapping lanes through the forage crop before flooding in the fall. These lanes make it much easier to wade through the pond and locate traps during harvesting.

Ponds that cannot be drained or planted can produce crawfish by encouraging natural aquatic vegetation. Native aquatic plants (like alligatorweed and smartweed) are good forage for crawfish but generally produce fewer crawfish than planted forage crops.

Flood-up

Timing of fall "flood-up" and management during the first few weeks after flood-up is essential for good crawfish production. Ponds flooded too early will have problems with rapid vegetation decay and associated oxygen depletions. Ponds flooded too late will lose many young-of-the-year crawfish because of starvation, cannibalism, or poor water quality in the burrows. Daytime temperatures should be 80° to 85°F and nights 60° to 69°F before ponds are flooded. Generally, flood-up should begin around October 1 in the Southeast.

The first few weeks (4 to 6) after flood-up are the most crucial. Rapid decay of vegetation during this period can cause an oxygen depletion. Adults can survive low dissolved oxygen by crawling up on the vegetation, but juveniles will suffocate. Flushing or aerating is the only management option that can save juveniles during an oxygen depletion. Testing for dissolved oxygen concentration should be part of routine crawfish pond management.

It is not necessary to completely fill the pond with water immediately, unless predation is a serious problem. Flooding with only 8 to 10 inches of water is sufficient to promote foraging by the crawfish but means less vegetation is subjected to decay and much less pumping or aeration is needed to maintain adequate dissolved oxygen concentrations. Add additional water every 7 to 10 days until the

pond is full and dissolved oxygen concentrations have stabilized. Decay rates will slow and dissolved oxygen concentrations will generally increase as the weather cools.

In Louisiana, crawfish ponds are flushed an average of nine times per season. Most crawfish farms in Alabama will not have the quantity of water available to flush ponds that frequently, especially in October and November. Therefore, Alabama producers will need to rely on aeration to maintain adequate dissolved oxygen concentrations.

Sampling The Population For Crawfish Size And Numbers

Sampling the crawfish population should begin about a month after flood-up. The crawfish population can be checked using a sturdy, small-mesh dip net (see photo) in shallow areas of the pond. The dip net is swept or dragged rapidly across the bottom in several areas of the pond. The number of juvenile crawfish and the different sizes of juvenile crawfish present is an indication of overall population and potential yield. Table 1 gives commonly used guidelines for crawfish yields based on sweep samples.

Yields listed in Table 1 are only potential, since an oxygen depletion can decimate the population or a lack of forage can result in starvation, poor growth, and reduced yields. To achieve these potential yields, water quality, particularly dissolved oxygen, must be maintained and adequate forage must be present.

Sampling for juveniles with small-meshed net in shallows.

Table 1. Estimation Of Potential Crawfish Yields Based On Dip Net Sweep Samples Of Juvenile Crawfish.

Number in each sample	Number of size groups	Potential	Probable yield pounds/acre)
8 or more	5 or 6	high	1500 - 2000
2 or 3	3 to 5	good	1200 - 1500
1	3	fair	400 - 500
1 every other dip	1 or 2	poor	100 - 200

Dip net sweeps can also be used to determine when to start harvesting. Egg development of female crawfish should be checked prior to beginning harvest. If more than 20 percent of the females have brown ovaries and juvenile numbers in the sweep counts are low, postpone harvesting for at least 2 weeks. This period will allow these females to produce a new group of young-of-the-year crawfish, which will increase the late spring harvest. However, if the sweep count is high (eight or more), harvest should begin immediately to prevent a problem with over-population which leads to stunting.

Water Quality

It is estimated that 99 percent of all production problems in crawfish ponds are related to poor water quality. Dissolved oxygen (D.O.) is the most serious problem, but pH, total hardness, total alkalinity, ammonia, nitrite, hydrogen sulfide, and iron can also affect crawfish production.

In general, pH should be in the 6.5 to 7.5 range in early morning; both total alkalinity and total hardness should be in the 50 to 250 mg/l range. If pH, hardness, or alkalinity are low, agricultural limestone should be added to the pond.

Ammonia (un-ionized form) and nitrite can be toxic to crawfish in the range of 2 to 4 mg/l or higher. However, it is extremely rare to reach these concentrations in crawfish ponds because of the low intensity of crawfish production and the uptake of these nutrients by aquatic plants growing in the ponds.

Hydrogen sulfide and iron are only encountered in well water. These compounds can be easily removed by aerating the water as it enters the pond.

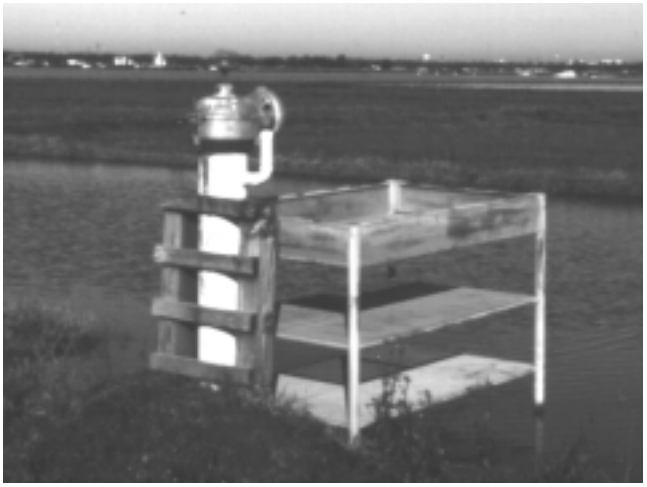
As noted earlier, the first 4 to 6 weeks after flood-up are the most critical in crawfish production. Conditions during this period will generally determine the overall production of a crawfish pond. If the newly hatched juvenile crawfish are lost during this period, harvestable crawfish will not be available until the late spring, as a second wave of reproduction reaches market size (from females that matured in late fall).

A newly flooded pond will generally have low D.O. concentrations because of rapid decay of vegetation and warmer temperatures. Ponds with large numbers of weeds (plants other than the planted forage crop) will have more rapid decomposition rates than ponds without weeds. Establishing a good forage crop without an abundance of unwanted weeds should be a management goal.

D.O. concentrations should be maintained at or above 3 mg/l in crawfish ponds. D.O. concentrations between 1 and 3 mg/l indicate crawfish are stressed. Crawfish do not eat or grow well at these D.O. concentrations. D.O. at or below 1 mg/l will kill many crawfish, particularly the juveniles. D.O. should be checked routinely. The lowest D.O. concentrations will be observed near dawn, therefore, testing and most aeration should be done in the predawn hours. **Routinely monitor D.O. and try to maintain at least 3 mg/l.**

Increasing the D.O. in a pond can be accomplished through flushing the pond with fresh water, circulating water through the pond using either relift pumps or aerators, or using some combination of these. Most farmers in Alabama may not have wells with enough capacity to flush ponds. A well capacity of 70 to 100 gallons per acre per minute is needed to adequately flush a crawfish pond.

Most crawfish ponds in Alabama should be designed to recirculate water since abundant well or surface water may not be available. Large crawfish ponds (greater than 5 acres) can be built with a return canal (Figure 1). Either a relift pump with screens or a paddlewheel aerator (see photos) is then used to circulate and aerate water from the pond, through the return canal, and back to the pond. On most ponds smaller than 2 acres you can use paddlewheel aerators without the need for a return canal or baffle levees. A 5-horsepower paddlewheel aerator will move 6,000 gallons of water per minute at relatively low cost. It is more economical to operate an electric aerator than it is to pump water.



Well or relift circulation pump with screen aerator.

Paddlewheel circulator or aerator.

Pesticides

Crawfish ponds should not be constructed near other agricultural crops that will require frequent use of pesticides or allow heavy runoff of fertilizers. Crawfish are close relatives of insects and are susceptible to many insecticides. Crawfish are also very sensitive to petroleum products.

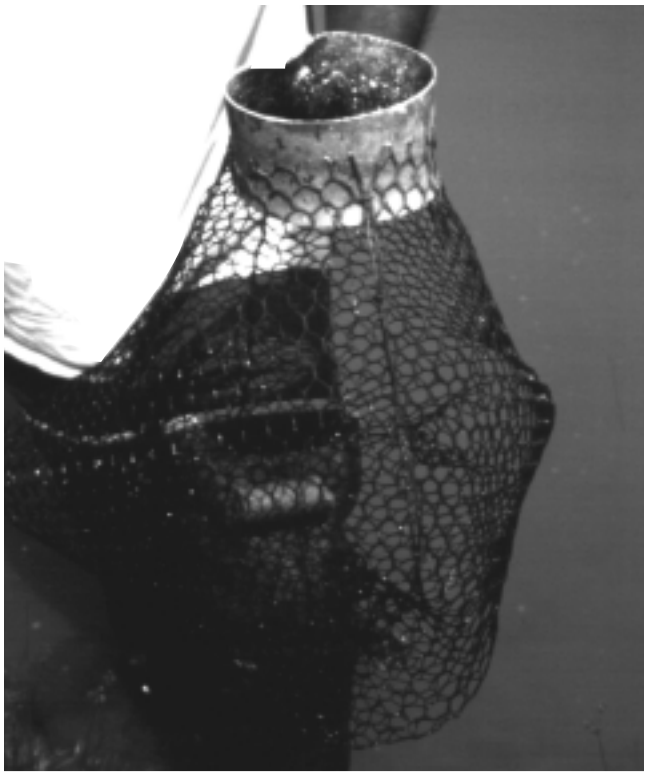
Only two insecticides are currently labeled for use on crawfish—malathion and *Bacillus thuringiensis* or *Bt*. Three **herbicides** are labeled for use in crawfish ponds—Propanil, Rodeo, and 2,4-D. No **fungicides** are labeled for use in crawfish ponds. Pesticide regulations change frequently. Check with your county Extension agent or Extension specialist for current recommendations. **Always read and follow label instructions.** All other pesticides should be avoided in crawfish production.

Predators

Many species of fish, reptiles, birds, and mammals will eat crawfish. Reptilian predators include snakes, turtles, and small alligators. Most wading bird species like herons, egrets, and ibises relish crawfish. Otters, raccoons, and Norway rats readily consume crawfish and can become adept at removing them from traps. Most would-be predators can be scared from ponds, but it takes diligence and persistence on the part of the manager. Many of these predators are protected by state or federal laws. Check with your local state game and fish biologist about current laws and regulations governing the removal of these animals. Muskrats and nutrias do extensive damage to pond levees and should be discouraged.

Harvesting

Harvesting crawfish is very laborious and accounts for up to 80 percent of total production costs. The crawfish harvest begins in November or December and can continue until early June. Of course, poor water quality after flood-up may reduce crawfish populations to the point of eliminating fall harvest. In well-managed crawfish ponds, harvest is approximately one-third from November through



Pyramid trap.

February, one-third in March and April, with the balance in May.

Crawfish caught in mid-November and December will be the adults and juveniles that survived from the previous spring. Early November harvest of adult females that are ready to spawn (brown eggs) may reduce your late spring harvest (see Sampling The Population For Crawfish Size And Numbers, page 8).

Crawfish are harvested by trapping. Research has shown that the best overall trap design is the pyramid trap (see photo) made of plastic mesh or plastic-coated wire. Mesh size is usually ¾ inch for food-size crawfish. A smaller mesh size can be used for capturing bait-size crawfish. Traps made of plastic-coated mesh are more efficient and durable than traps made of galvanized mesh.

Generally, traps are placed in rows at 20 traps per acre approximately 35 to 50 feet apart. Traps can be run daily, but research has shown that unless the crawfish population is overcrowded it is more economical to trap consecutively 3 or 4 days per week.

Traps are baited with either fish or commercially manufactured baits at ¼ to ⅓ pound per trap. Fish commonly used for bait are shad, carp, menhaden, or catfish carcasses (after processing and spines removed). Fish is the best bait at water temperatures below 60°F. Manufactured bait works best at temperatures above 70°F, and a combination of fish and

Crawfish harvesting by boat or "combine."

manufactured bait is used at temperatures between 60° and 70°F. Traps are usually baited in the afternoon and harvested the following morning. Trapping is not effective at water temperatures below 50°F.

Running traps is labor intensive. A single person wading through the pond checking traps—and pushing a tub or boat to hold the catch—can run 30 to 50 traps per hour or 400 traps per day, the equivalent to harvesting 20 acres per day. Utilizing a hydraulically powered boat or "crawfish combine" can extend harvest rates to 150 to 200 traps per hour, 2,000 per day, or the equivalent of a 80 to 100 acres per day.

Graders can be built or purchased that will separate small crawfish and debris from the larger crawfish during harvest. Properly constructed graders let small crawfish drop back into the pond while funneling larger crawfish into transport bags. Bait and debris should be removed from the crawfish before they are sacked or bagged. Citrus or onion sacks are the best containers for holding and transporting crawfish. Crawfish should be packed tightly into the sacks so that they cannot move around freely. Crawfish will kill each other if too loosely sacked. A standard onion sack will hold 40 to 50 pounds of crawfish.

Transporting And Storage

Live crawfish are relatively tough creatures. However, they are easily killed if mishandled. Remember—a dead crawfish, no matter how "fresh dead," should **not** be eaten. One of the first things a novice will be told at a crawfish boil is "Don't eat the straight tails—they were dead before they hit the pot." Live crawfish immediately curl their tails when they are dropped into boiling water.

Avoid putting more than 50 pounds in a sack—*too* much packing can crush softer crawfish. Early season crawfish may be softer and thinner shelled, so don't pack them as tightly. Late season crawfish generally have harder shells. Handle sacks gently and

never stack sacks more than three high. Treat them like eggs to insure a quality product.

When transporting and storing crawfish, the key is to keep them cool, moist (but not submerged in water), shaded, out of the wind, and away from petroleum or other chemicals that could kill or contaminate them. Place the sacks on clean pallets when transporting in a truck or boat to allow air to circulate around them and to keep the crawfish out of spilled diesel, gas, oil, grease, etc. Cover the sacks with wet canvas, burlap, or toweling. **Keep the sacks moist.** Remember crawfish have gills similar to fish but will survive in moist air. Crawfish that are too dry will lose weight and die. Hauling crawfish in an airtight container (for example, an ice chest) will suffocate them. Top the moist toweling with ice when hauling crawfish a long distance in warm weather.

Crawfish are best stored in a high humidity cooler at 38° to 50°F (38° to 42°F optimum). Get freshly harvested crawfish to a cooler within 2 to 3 hours. Crawfish will survive only a few hours if air circulation is poor. Properly handled crawfish will live and be of good quality for 4 or 5 days after harvest in a well-designed and properly operated cooler.

Purging

What many people call purging is simply washing or rinsing. Often debris (grass and bait) will persist in the bagged crawfish. Empty the bags of crawfish into a tub and remove debris. Wash and drain water from the crawfish at least three times or until the water remains clear. Some people add salt in the rinsing process, but salt stresses the crawfish and will kill many of them. **Do not add salt while rinsing live crawfish.** Once clean, the crawfish are ready to boil!

A few producers truly "purge" crawfish. Since the intestine of the crawfish runs the entire length of the tail muscle, purging of the digestive tract may improve the flavor. Purging is done by flushing the crawfish with cool, aerated well water for about 2 days. The crawfish are usually held in vats or trays with screened bottoms to allow wastes to wash away. After 2 days the crawfish has emptied its digestive tract.

Expected Yields

Crawfish harvest yields and total production are two different things. Efficient and economical harvesting techniques will yield the highest returns.

First-year production in well-managed Alabama crawfish ponds have averaged about 500 pounds per acre. Second-year yields have averaged around 750 pounds with a few farms producing 1,000 pounds per acre. An excellent average crawfish production would be 1,200 to 1,500 pounds per acre. A producer will rarely achieve 1,500 to 2,000 pounds per acre in a single pond. The average Louisiana crawfish pond yields 800 to 1,000 pounds per acre. The peak month for harvesting in Alabama is May.

Research in Louisiana indicates that utilizing interior baffle levees and paddlewheel aerators can efficiently circulate and aerate water in large crawfish ponds. This system provides high consistent D.O. levels which can increase yields and extend the production season. The limiting factor to constructing large ponds in this fashion is that it is very site selective (and must be very flat).

Marketing

Since Alabama's crawfish industry is in its infancy, crawfish markets are limited to direct sales to consumers, locally owned restaurants, seafood markets, and caterers. Larger volumes of crawfish are needed to justify a processing or "peeling" plant. Peeling plants in Louisiana are capable of peeling 500,000 pounds of tailmeat annually, and since frozen tail meat is easily marketed via refrigerated transport, regional price competition may be intense. Alabama's limited production will not economically justify a peeling plant in the foreseeable future.

The backbone of market demand for crawfish in Alabama has been transplanted Cajuns and Alabamians who enjoy Cajun cuisine. Cajun cuisine, popularized by trendy restaurants, has helped increase demand for crawfish throughout the country. These cousins of lobsters are delicious, and word-of-mouth advertising usually suffices to create markets for small producers. Alabama producers should advertise locally with fliers and business cards.

Live crawfish are perishable. They must be marketed quickly, often within 3 to 4 days after capture. Producers soon learn that crawfish are a Thursday, Friday, and Saturday commodity, and you may be hard pressed to give them away on Mondays. Plan your trapping to accommodate your markets!

Historically, live crawfish prices in Alabama range from a low of $0.85 per pound to a high of $1.50 per pound. Fresh boiled crawfish usually command around $2.00 per pound. For this reason some crawfish producers have become crawfish boil caterers or have turned their kitchens into lucrative home-based businesses by cooking various dishes, such as etouffee and crawfish pies, which they sell locally. Consult local health codes before embarking on a cooking or catering enterprise.

Smaller crawfish (40 count) can be marketed as fish bait. Wholesale prices for bait crawfish are around $4.00 a pound. Retail prices in Alabama for bait crawfish are $7.00 a pound or $2.50 a dozen. In

Table 2. Crawfish Enterprise Budget.*

Item	Unit	Quantity	Price or cost/unit	Total value/cost
1. Gross receipts				
Crawfish (pond run)	lb.	4000	1.25	5000.00
2. Variable cost				
Forage (rice)	acre	5	63.35	316.75
Bait	lb.	2030	.35	710.50
Labor	hr.	175	.00	.00
Sacks	each	98	.35	34.30
Electricity	kwh	3170	.075	237.76
Facility and equipment repair	dol.			188.50
Interest on operating capital	dol.	744	.085	63.23
Total variable cost				1551.04
3. Income above variable cost				3448.96
4. Fixed costs				
General overhead	acre	5	5.00	25.00
Forage (rice)	acre	5	10.36	51.80
Interest on broodstock capital	dol.	350	.09	31.50
Interest on building and equipment	dol.	4298	.09	386.78
Depreciation on building and equipment	dol.			923.00
Other fixed costs on building and equipment	dol.			60.38
Total fixed costs				1478.45
5. Total costs of all specified expenses				3029.49
6. Net returns above all specified expenses				1970.51
Net returns per acre: Above specified variable expenses				689.79
Above specified total expenses				394.10
Break-even price (per cwt sold): To cover specified variable expenses				38.78
To cover specified total expenses				75.74
Labor cost ($5/hr) included:				
Net returns per acre: Above specified variable expenses				507.35
Above specified total expenses				211.66
Break-even price (per cwt sold): To cover specified variable expenses				61.58
To cover specified total expenses				98.54

Facilities And Equipment

Item	Price per unit	Number	Proportion charged	Total charged	Salvage value (%)	Years of life
Water quality kit	175	1	1	175	0	5
Traps	8	100	1	800	0	4
Cooler	800	1	1	800	0	10
Scales	100	1	1	100	0	10
Waders	125	2	1	250	0	2
Aerator (5 hp)	3300	1	1	3300	5	10
Pump (350 gal./min.)	600	1	1	600	5	10
Pond construction	475	5	1	2375	0	10
Total facilities and equipment				8400		
Broodstock	1	350	1	350		
Total investment				8750		
Total investment per acre				1750		

*For a 5-acre crawfish budget: estimated annual costs and returns; using recommended management practices; 800 lb./Acre average yield; Alabama, 1994. These estimates should be used as guides for planning purposes only.

order to consistently catch bait crawfish, the traps should be constructed with 1/2-inch mesh instead of the usual 3/4-inch mesh.

Economics

Potential profits from crawfish farming are greater than for most rowcrop enterprises in Alabama. The production risks are a great deal less than for commercial catfish production. The biggest drawback to crawfish production is being **unable to predict yields,** since Mother Nature to a large degree determines whether or not crawfish are going to enter the traps. A producer may take orders for 200 pounds and only catch 150 pounds.

The biggest factor determining profitability is the cost of harvest. If the producer plans to personally harvest the crop, he or she must decide what a fair return will be for investment, management, and labor. For production cost estimates please refer to the Crawfish Enterprise Budget (Table 2).

Pond construction expenses are highly variable. Generally, the larger the pond the less expensive it is to build on a per-acre basis. The engineer at the Alabama Fish Farming Center, using actual pond construction expenses for crawfish ponds built in Alabama, has compiled data on construction costs (Figure 4). Figure 4 shows that pond construction costs range from $1,100 per acre for small ponds to $375 per acre for large ponds.

Enterprise Budget Analysis

An estimated annual cost and return analysis for a 5-acre pond is shown in Table 2. While a 5-acre unit may not be considered economically feasible in Louisiana, it is felt that this size unit would be preferable in Alabama because of topographic limitations as well as the infancy of the industry and our new, possibly limited markets. The estimates (yields, input costs, prices, etc.) reflected in the enterprise budget are realistic and achievable given that the producer follows recommended management practices and recognizes the importance of market price.

"Variable" or "out-of-pocket" costs for a 5-acre unit are estimated at approximately $1,550. Bait costs are by far the most expensive item, totalling more than $700, or almost 50 percent of total variable expenses. Establishing rice or other forage and electrical power associated with operating the aerator and pump are also major expenses.

"Fixed" costs represent those expenses that are incurred once the decision is made to invest in crawfish production. These costs do not vary with produc-

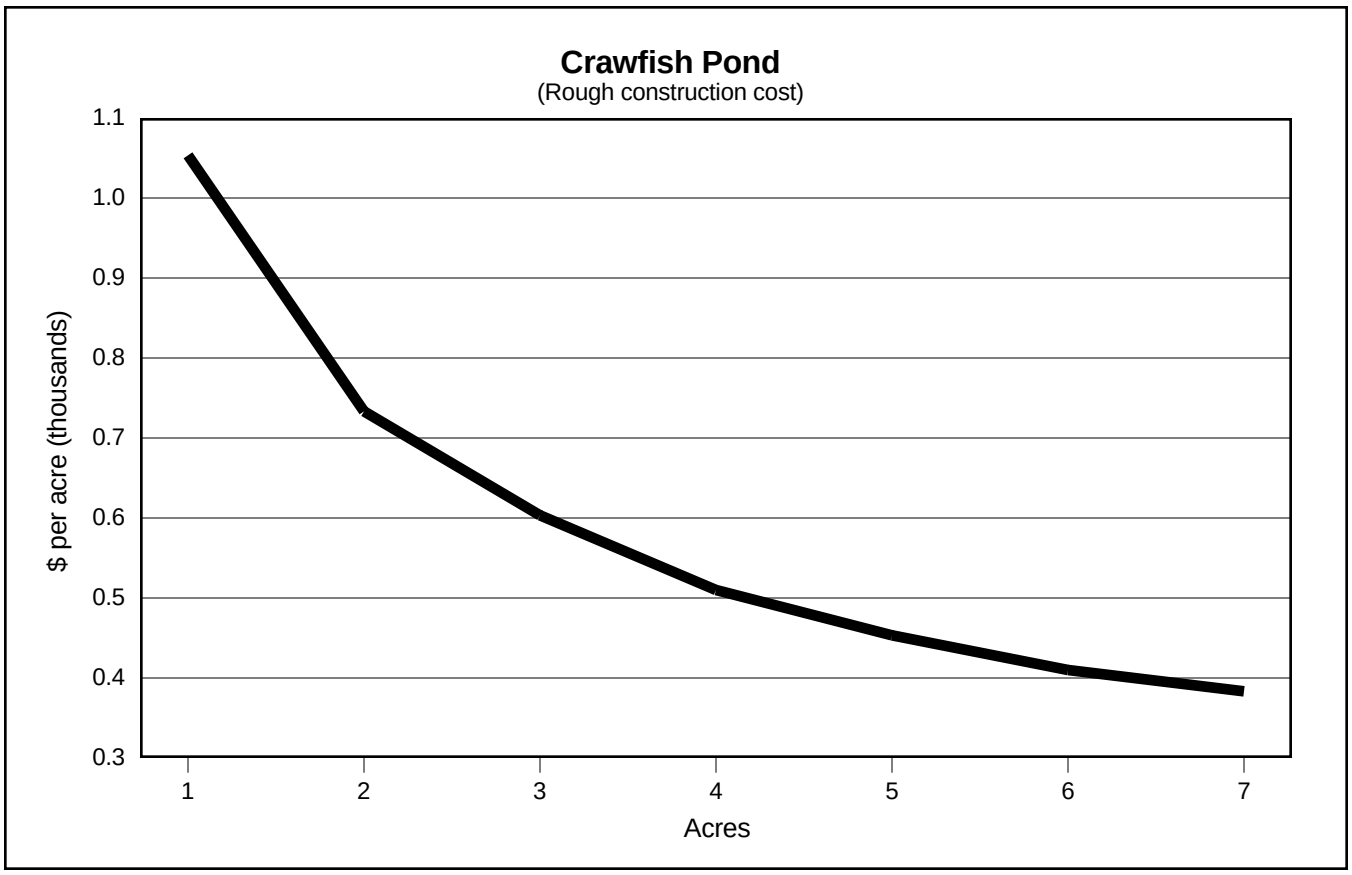


Figure 4. Actual pond construction expenses for crawfish ponds built in Alabama.

tion levels but should be accounted for if the enterprise is to continue over the long-term and allowances (depreciation or interest on investment monies) made for replacement of the various investment items such as aerators, pumps, pond construction, etc. When all these costs are totaled (almost $1,500), they amount to almost as much as the variable costs.

Assuming an average yield of 800 pounds per acre and an average selling price of $1.25 per pound, the net return per acre is approximately $700 over variable costs and almost $400 over total costs (notice that labor has not been charged).

The break-even point to cover variable expenses for 800 pounds per acre production amounts to almost $.40 a pound. When fixed costs are added, the break-even point jumps to just over $.75 per pound.

If labor costs are considered, net returns per acre would be reduced to approximately $500 and $200 over variable and total costs, respectively. Further, labor would increase break-even costs by approximately $0.23 per pound.

Investment costs for a 5-acre operation amount to $8,750 or $1,750 per acre. It should be pointed out that as larger acreages are considered, unit costs will likely decrease on such investment capital as pond construction, aerators, coolers, and pumps.

Table 3 reflects the sensitivity that varying yields and selling prices have on "net returns." This table should give some measure of risk exposure for persons considering an investment in the crawfish business. While projected prices are well above those experienced in Louisiana, these estimates could decrease as acreage increases. However, prices should remain strong into the near future.

Table 3. Estimated Returns Per Acre Above All Specified Expenses (Excluding Labor) At Various Production And Price Levels*

Expected yield per acre (lb.)	Price received for crawfish ($/lb. .75	1.00	1.25	1.50	1.75
			$/acre		
640	-124	36	196	356	516
720	-65	115	295	475	655
800	-6	194	394	594	794
880	53	273	493	713	933
960	112	352	592	832	1072

*Costs associated with "variable" input items have been adjusted. Costs associated with "fixed" investments are held constant.

Conclusion

This publication was designed to be a guide for individuals who are considering crawfish production. Crawfish production in Alabama will be limited by soils and access to adequate water. However, as with any type of alternative agriculture, an individual's success will be limited by his or her ability to market the product at an acceptable profit margin.

Additional information about producing crawfish can be provided by an Extension fisheries specialist or Extension aquaculture specialist with the Alabama Cooperative Extension System and Auburn University. For recipes on how to cook crawfish, ask your county Extension office for the video and Timely Information sheet called "Cooking Crawfish."

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Issued in furtherance of Cooperative Extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, and other related acts, in cooperation with the U.S. Department of Agriculture. The Alabama Cooperative Extension System (Alabama A&M University and Auburn University) offers educational programs, materials, and equal opportunity employment to all people without regard to race, color, national origin, religion, sex, age, veteran status, or disability.

UPS, 6M29, Rep. 5:97, ANR-891

ALABAMA COOPERATIVE Extension SYSTEM

ANR-891