



CRAWFISH PRODUCTION MANUAL

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Dedication



Laurence Willard de la Bretonne Jr.

Laurence Willard de la Bretonne Jr. served as state aquaculture specialist with the Louisiana Cooperative Extension Service for more than 15 years, managing educational programs dealing with crawfish, alligators and soft-shell crabs. A native of Houma, La., he received many professional honors and served on numerous national and state committees concerned with the advancement of aquaculture.

Larry was recognized as an international authority on the culture of crawfish and, to a large degree, influenced the growth and development of the crawfish aquaculture industry in Louisiana. He had the ability to transform very technical research findings into information useful to farmers.

Larry's dedication and enthusiasm for his work with the Louisiana crawfish industry remain an inspiration. The authors are proud to dedicate this manual to him.

Introduction



Dating back to native Americans and early European settlers, crawfishing has been a part of Louisiana culture. Crawfish were abundant in the swamps and marshes across south Louisiana and provided a ready source of food. As a commercially available food source, crawfish can be traced back to New Orleans French Market records in the 1800s. A commercial fishery for wild crawfish developed in the Atchafalaya River swamp in the 1940s, and large quantities of crawfish continue to be harvested from this region each year. Crawfish processing evolved as a way to salvage tailmeat from those crawfish which could not be sold live.

Catches from the wild were unpredictable. Increased consumer demand for crawfish stimulated the development of the crawfish farming or aquaculture industry in Louisiana. From just a few experimental crawfish ponds in the 1950s, pond acreage increased steadily over the next 45 years. Louisiana is presently the world's largest producer of crawfish. Crawfish are grown throughout Louisiana, with production concentrated in the south-central portion of the state (Figure 1). Both production acreage (Figure 2) and annual production of farm-raised crawfish (Figure 3) have increased dramatically since 1960.

Early crawfish farming efforts involved using leveed woodlands that received water pumped from rivers and bayous. Yields were low by present standards. Production systems were refined over the years through experience and application of research findings. Crawfish are still produced in wooded and naturally vegetated ponds, but most farming occurs in rice fields. Crawfish farming fits well into many existing farm operations by using marginal agricultural lands, permanent farm labor and farm equipment during off-peak farming periods.

Crawfish ponds vary widely in shape and size. Typical ponds are 10 to 20 acres, and most producers manage 100 acres or fewer. Formulated feeds are not used to feed crawfish. Instead, vegetation, such as rice, sorghum-sudangrass or natural aquatic plants, are established in the summer to serve as a



Figure 1. Major crawfish-producing areas of Louisiana

food-base for crawfish. Crawfish ponds are not stocked with hatchery reared young as are other forms of aquaculture. Farmers rely on reproduction by unharvested, holdover crawfish from the previous year or on previously stocked broodstock to produce young.

The profitability of crawfish farming changes from year to year. Yields, costs and prices are unpredictable. They also vary by each type of crawfish production system. Break-even prices vary greatly from farm to farm and in different regions of the state. Prospective producers should review current financial budgets available from the LSU Agricultural Center and discuss the feasibility of their projects or business plans with an Extension Service agent. The agent can identify the best available data at the time of the request.

Educational and technical assistance in all aspects of crawfish production and marketing is provided by the Louisiana Cooperative Extension Service in your parish. Help is available through individual consultation, on-farm visits, production meetings and publications. Consequently, agents remain the best source of information on the feasibility of crawfish farming in your area.

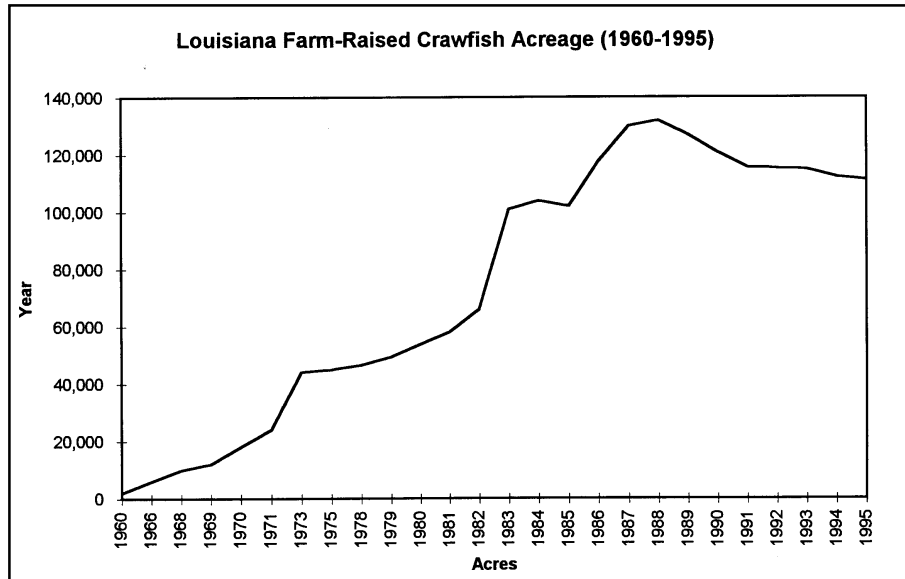


Figure 2. Louisiana farm-raised acreage devoted to crawfish production (1960-1995)

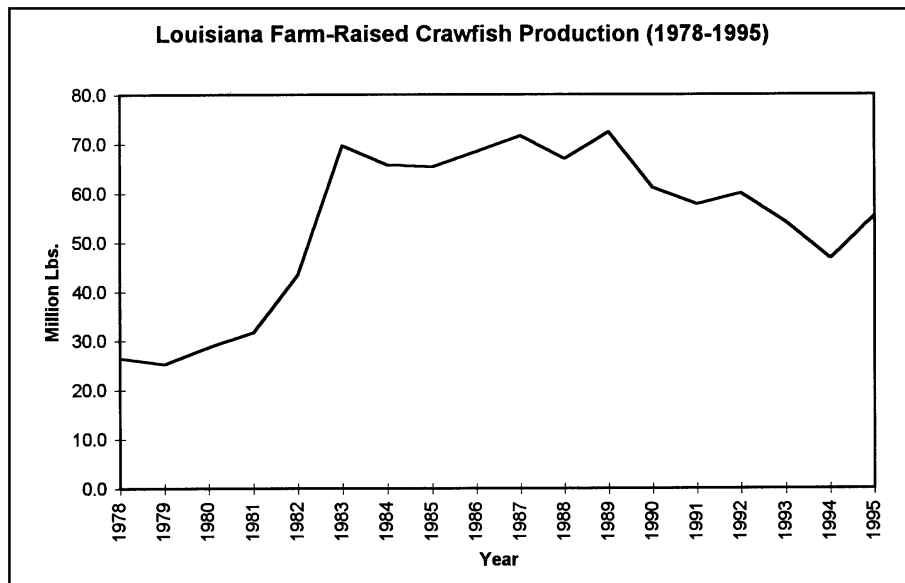


Figure 3. Yearly crawfish production in Louisiana between 1978 and 1995

Crawfish Biology



Life History

At least 32 species of crawfish have been identified in Louisiana. The two species of economic importance are the red swamp crawfish, *Procambarus clarkii*, and white river crawfish, *Procambarus zonangulus* (formerly *P. acutus acutus*). Both species are grown together in the same ponds. Industrywide, the red swamp crawfish comprises 70% to 80% of the annual catch.



Male white river crawfish (left) and male red swamp crawfish (right)

Adult red swamp crawfish can be easily distinguished from adult white river crawfish. Young specimens also can be differentiated, but it's more difficult. In red swamp crawfish, the two halves of the carapace meet to form a thin line. White river crawfish exhibit a separation between the two halves of the carapace. Mature white river crawfish have claws that are more elongated and cylindrical than those of the mature male red swamp crawfish. White river crawfish have much lighter colored walking legs when viewed from above. Also, red swamp crawfish exhibit a pigmented line, referred to as the "vein" on the underside of the tail. This is not present on the white river crawfish.

When crawfish become sexually mature, they assume distinctive characteristics. The claws of male crawfish become longer and wider. Males of both species also develop hooks at the bases of the third and fourth pairs of walking legs. The large

claws and hooks help the male grasp the female while mating. The male's first two pairs of modified swimmerets, called gonopods, become hardened and serve to transfer the sperm packet, called spermatophore, to the female. The female does not go through as elaborate a transformation, but her claws become larger. Sexually mature females also exhibit a distinct groove in the sperm receptacle, or annulus ventralis, located between the walking legs.



Mature female red swamp crawfish (above) and mature male red swamp crawfish (below)

Mature crawfish mate in open water all year, but mating peaks in the Deep South from May through June. It's not uncommon for a male crawfish to mate with more than one female. The female stores the spermatophore in the seminal receptacle until spawning. After mating, the female burrows into the levee 4 to 6 inches above the water level.

After an ovarian development period of two to five months, and while crawfish are in burrows, eggs are extruded through the oviducts, fertilized and attached to the swimmerets on the underside of the belly. About 300 eggs are extruded by females, with a range of 100 - 700 eggs, depending on the female's size. The eggs usually hatch in two to three weeks under ideal conditions, but may take as long as three to four months in winter. Red swamp crawfish usually produce up to twice as many eggs as white river crawfish.

Burrowing

Crawfish aquaculture relies on control of pond hydrology to simulate optimal wet and dry conditions occurring in the natural habitat. Crawfish grow and mature during the wet or flooded cycle and have adapted to survive the dry periods by digging burrows.

During dry periods, juvenile and mature crawfish of both commercial species construct and inhabit underground burrows. Burrows serve as a refuge from predators and provide a moist environment necessary for crawfish to survive until high water returns. Most crawfish eggs are laid, and many are hatched, while female crawfish are in burrows.

Early maturing crawfish begin burrowing activity along pond levees by mid-April. Burrowing activities increase as summer approaches and water temperatures rise. With the exception of mature females, most burrowing occurs as ponds are drained. Crawfish follow the receding water line and move into existing old burrows or dig new ones. Burrows tend to be clustered around clumps of standing vegetation or any form of cover along the levee. Few burrows are on the pond bottom.

Most burrows are built at night and may require several days to build. Crawfish burrows are usually dug by an individual crawfish. The burrow is generally 1 to 3 feet deep, but may be deeper during drought conditions. Burrows usually consist of a single vertical tunnel. Its diameter is determined by the size of the crawfish. The burrows extend downward into a terminal chamber. The chamber is filled with several inches of wet slush, which serves as a humidifier when water is not present in the hole. Water levels in burrows vary with the depth of the water table and rainfall. The opening of the completed burrow is covered at the top with a chimney or mud plug.

Burrows are typically occupied by a pair of adult crawfish of the same species. Juvenile crawfish hatched in the burrow are also present by early fall. During the winter, mature males tend to be absent

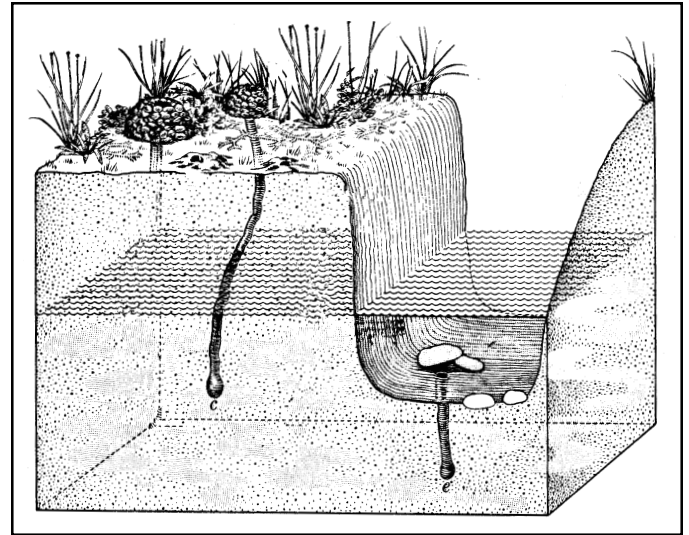


Figure 4. Cross-section of crawfish burrow.

from the burrow, but mature females and juvenile crawfish may be found in a single hole.

Under normal conditions, crawfish in commercial crawfish ponds must survive for four or five months (June-October) in the burrow. Survival depends on their physiological condition at the time of burrowing and the conditions they are exposed to while in the ground. The presence of water in the burrow appears to be the most important factor affecting broodstock survival and egg laying.

Crawfish ponds are filled in the fall to coincide with peak spawning of females in burrows. When burrows are filled with water, adults and juveniles leave the burrow and distribute themselves throughout the pond. The rate and time of juvenile emergence after flood-up vary.

During flood-up, moisture softens the mud plug, allowing crawfish to emerge. Farmers who flood ponds to a shallow depth (6-8 inches) early in the season minimize the need for pumping, but this may leave crawfish that burrowed at the fishing level depth trapped in the ground until heavy rain storms or a full flood level (18-22 inches) is achieved.

The survival and reproductive success of broodstock in burrows have a major impact on the crawfish crop following flood-up. Researchers have only recently begun to study crawfish burrowing and reproductive biology and ecology.

Population Dynamics

There are usually groups of several sizes of crawfish in a pond. The general classification of the population structure is based on age. These groups include (1) holdover adults from the preceding production season, (2) holdover juveniles from the preceding season and (3) this year's juvenile crawfish. Spawning does not take place at one time, so there are several age classes of crawfish. The appearance of juvenile crawfish is called recruitment. The number of age classes, numbers within age classes (density), survival rate, food availability and water quality determine overall pond yields and harvest size. Most highly productive crawfish ponds develop at least five age classes by winter following flood-up. Sporadic and low intensity crawfish recruitment may take place all year. High levels of recruitment occur in September and October, with a secondary peak in November and December.

Growth

Juvenile crawfish grow rapidly and can reach harvestable size (20-25 per pound) in three to four months if growing conditions are favorable. Growth rate is influenced by water temperature, so crawfish hatched in late fall or mid-winter require four to five months to reach harvestable size. Crawfish have a natural life span of no more than two or three years in the Deep South.

Growth occurs by shedding the shell, or exoskeleton. This is referred to as molting. Increases in length and weight during molting vary significantly with water temperature, water quality, food availability and crawfish densities within the pond. Crawfish can increase 15% in length and 40% in weight with each molt if they are properly fed and water conditions remain good.

Good water quality and adequate food are essential to good growth, though the key factor is density. A sparser, low density population produces larger crawfish, whereas a dense population produces small, stunted crawfish. A better understanding of the linkage between food components and crawfish growth is needed.

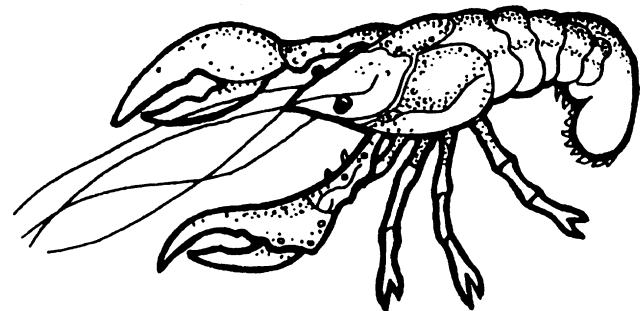
Diseases

Primary disease pathogens of crawfish include bacteria, fungi, protozoans and parasitic worms. Disease problems associated with extensive crawfish culture as practiced today have been minor, but further studies may indicate that diseases are more important when crawfish are stressed in the burrows and when poor water quality prevails during initial flooding.

Potential bacterial pathogens of crawfish are common inhabitants of stagnant water and decomposing vegetation and have been implicated in external and internal infections in cultured crustaceans. Increased bacterial levels may affect the survival and quality of crawfish during transportation, storage and handling after harvest. It has been suggested that ponds drained late in the season, when water temperatures are high, will have a reduced survival of crawfish in the burrows. High mortalities in the burrows reduces recruitment of juveniles the next year.

A serious fungal disease in the native populations of European crawfish is called the crawfish plague. It is caused by the fungi of the genera *Aphanomyces* and has caused high mortalities in European crawfish. Red swamp and white river crawfish appear to be resistant to this fungus.

Though not parasites, aquatic insects such as water boatmen may lay their eggs on the carapaces of crawfish. Heavy infestations reduce the marketability of encrusted crawfish, although consumption of these crawfish when thoroughly cooked is not a health hazard to humans.



Crawfish Production Systems



The life cycle of crawfish can be manipulated to fit a variety of management requirements and can be integrated into an agricultural crop rotation. There are two principal classifications of crawfish ponds: permanent ponds and rotational ponds. Permanent ponds describe those ponds that are in the same location and have a continuous management scheme applied year after year. The term “rotational” refers to the practice of rotating the annual sequence of crops grown in a pond or rotating the physical location of the field in which crawfish are grown.

Permanent Ponds

An estimated 50% of Louisiana crawfish ponds are classified as permanent. The three principal types are single crop crawfish ponds, naturally vegetated ponds and wooded ponds.

The following crawfish culture cycle is applicable to each of the three types as follows:

Permanent Crawfish Pond

April - May - Stock 50-60 lbs of adult crawfish per acre (new ponds only)

May - June - Drain pond over 2 - 4 week period

June - August - Plant crawfish forage or manage natural vegetation

October - Reflood pond (based on air temperature)

November - May/June - Harvest crawfish

May/June - Drain pond and repeat cycle without restocking crawfish



Single crop crawfish pond

Single Crop Crawfish Pond - Single crop crawfish ponds are constructed and managed solely for the purpose of cultivating crawfish. During the summer (May-August), a forage crop is allowed to grow. Crawfish can be harvested in single crop crawfish ponds one to two months longer than rotational systems because there is no overlap with planting, draining and harvesting schedules of other crops. Pond design is often optimized to improve production by using baffle levees and recirculation systems. Because of pond management capabilities, single crop crawfish ponds yield the highest pounds of crawfish per acre.



Naturally vegetated pond (alligatorweed)

Naturally Vegetated Ponds- This term refers to marsh impoundments and agricultural lands that are managed to encourage the growth of naturally occurring vegetation. Marsh ponds are typically constructed in wetland areas. They are characterized by high amounts of organic matter in the soil. This often lowers water quality, decreasing crawfish production. Although these ponds may be managed exclusively for crawfish, production is often sporadic and marsh ponds usually have the lowest yields of all permanent ponds. Though marsh ponds do exist in Louisiana, they are generally not recommended for commercial crawfish production because yields are inconsistent from year to year.

Agricultural lands unsuited for growing grain crops because of improper drainage or inadequate soil types are sometimes used for naturally vegetated ponds. Establishment of an adequate forage base consisting of both aquatic and terrestrial plant species can be difficult. Water can be managed to select for aquatic vegetation over terrestrial species. One or more aquatic species is allowed to grow in summer and fall. Limited cultivation and fertilization can stimulate stand establishment.



Wooded pond

Wooded Ponds- These ponds are built on heavy clay soils in forested (cypress-tupelo swamps) areas near drainage canals. Production is limited by the inability to manage water effectively. Wooded ponds have poor stands of vegetative forage and water temperatures tend to be lower because of shading. Leaf litter provides the bulk of forage, but rapid leaf fall can cause poor water quality. Water flow and crawfish harvest are difficult because trees hinder water movement and obstruct access by harvesting boats. Trees are sometimes removed to provide boat access to traps.

After several years of alternate flooding and drying, wooded ponds have a high loss of hardwood trees. A natural vegetation base of terrestrial grasses and aquatic plants is subsequently devel-

oped, improving crawfish habitat. Improved water circulation and more intense water management are needed to maintain good water quality in wooded impoundments. Poor circulation and decomposition of flooded vegetation lead to deterioration of water quality because oxygen may become depleted during decay. Wooded ponds usually produce fewer pounds of crawfish per acre than other management regimes, but large crawfish may produce a profit.

Some positive aspects of wooded ponds are: potential for waterfowl hunting, low initial start-up costs and selective removal of unwanted vegetation.

Rotational ponds

The most common crawfish-agronomic crop rotations are rice-crawfish-rice, rice-crawfish-soybeans, rice-crawfish-fallow and field rotation. In the rice-crawfish-rice rotation, rice and crawfish are double cropped annually. In the rice-crawfish-soybeans rotation, farmers have the opportunity to produce an additional grain crop during the rotation. In the rice-crawfish-fallow rotation, farmers can leave the field fallow for control of weeds and overpopulation of crawfish. In the field rotation culture system, crawfish and an agronomic crop are rotated within the same field for a certain number of years. At some point, the crawfish are restocked into a new field, and a new rotation is established in the new field.

Rice-Crawfish-Rice Ponds - Rice and crawfish are double cropped annually. Rice fields offer the most readily adaptable area for expanding crawfish culture. The rice farmer is capable of using the same land, equipment, pumps and farm labor that are already in place. After the grain is harvested, the remaining stubble is fertilized, flooded and allowed to regrow (ratoon). This ratoon crop serves as the forage base for crawfish. Total production is sometimes decreased because rice culture practices take precedence over crawfish production. Problems include conflicts regarding pesticide use and poor water circulation. These ponds are usually drained early (March 1 - April 1) to replant rice in the spring. This greatly shortens the crawfish harvest season and potential crawfish yield.

Rice-Crawfish-Rice Rotation

March - April - Plant rice

June - At permanent flood (rice 8 to 10 inches high), stock 50-60 pounds of adult crawfish per acre

August - Drain pond and harvest rice (later in north Louisiana)

October - Reflood rice field

November - April - Harvest crawfish

March - April - Drain pond and replant rice

Rice-Crawfish-Soybeans - This rotation allows for the production of three crops in two years. It also has the additional advantage of a longer crawfish harvest season than the rice-crawfish-rice rotation. Pesticide use is also an important management consideration in this rotation.

Rice-Crawfish-Soybeans Rotation

March - April - Plant rice

June - Stock 50-60 lbs of adult crawfish per acre at permanent flood

August - Drain field and harvest rice

October - Reflood rice field

November - May - Harvest crawfish

Late May - June - Plant soybeans

October - November - Harvest soybeans

November - March - Reflood pond and harvest crawfish

March - April - Plant rice (Restocking of crawfish is probably necessary)

Rice-crawfish-fallow - This rotation allows the farmer to leave the land fallow for a certain period. This is a common practice in the rice-producing region of southwest Louisiana. This fallow period allows the farmer to break the natural cycle of certain weeds and also prevents the overpopulation of crawfish.

Rice-Crawfish-Fallow Rotation

March - April - Plant rice

June - At permanent flood (rice 8 to 10 inches high), stock 50-60 pounds of adult crawfish per acre

August - Drain pond and harvest rice

October - Reflood rice field

November - June/July - Harvest crawfish

July - Drain pond

August - March - Fallow

March - April - Plant rice

Field Rotation - After several years in production, rotational ponds may develop stunted crawfish populations from overpopulation. One method of overcoming this problem is to rotate the location in which crawfish are grown. Once a stunting problem has been verified, mature crawfish from the affected pond can be used to stock a new pond that will be used in a crawfish - agronomic rotation. The affected pond is simply left dry during the normal part of the cycle that crawfish would be harvested. This is commonly done in south-central Louisiana. By reducing the density of reproducing females, stunting caused by overpopulation is reduced.



Site Location and Pond Construction



Location and pond design are the most important physical factors for successful crawfish production. Proper pond construction gives the crawfish farmer better control over flooding, drainage, forage management, water circulation and harvesting. Although management practices can be easily changed from year to year, trying to change ponds that were improperly constructed can be expensive. Seek advice from your parish Extension Service agent and the Natural Resources Conservation Service engineer in your area.

Location

Crawfish ponds should be located in flat, open areas, and the soils should have sufficient amounts of clay. Clay loams, sandy clay loam and silty clay loams are satisfactory soil types. A clay soil is necessary to hold water and to maintain the integrity of crawfish burrows because crawfish will die in burrows that collapse because of sandy soils. Generally, soils that can be rolled into a ball have enough clay for crawfish culture.

Construction

Perimeter levees should have a core trench cleared of debris to prevent water seepage. The minimum perimeter levee base should be 9 feet wide to prevent leakage from the burrowing activities of the crawfish. A levee system 3 feet high is

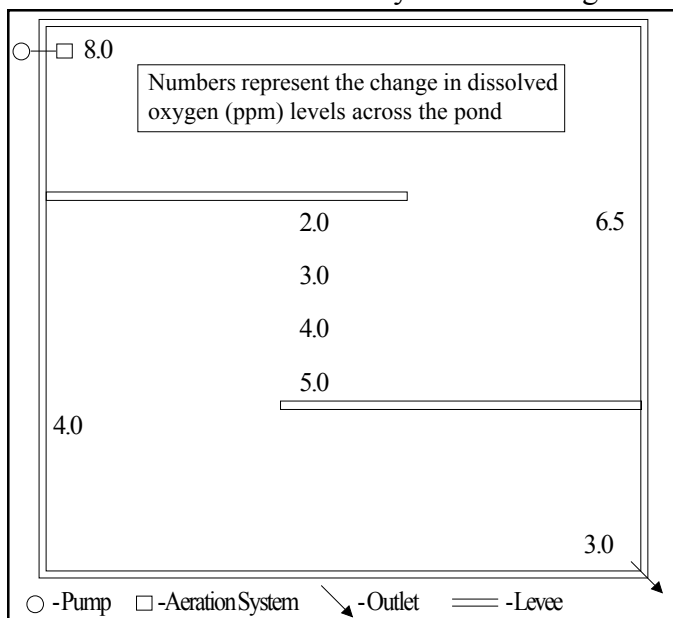


Figure 5. Construction plan for a crawfish pond showing a perimeter levee and baffle levees.

adequate to contain the 8 to 12 inches of water necessary to cultivate crawfish. The land should have no more than a 6-inch fall between perimeter levees. Otherwise, the area should be leveled or divided into two or more ponds. Ponds with a steep elevation difference restrict water management techniques and reduce harvesting efficiency.

Interior ditches reduce circulation, and areas away from the channel may be low in dissolved oxygen. This reduces the effective production area of the pond. Interior ditches are difficult to drain, and they may serve as a refuge for predatory fish after ponds are drained.

Interior or baffle levees are constructed to guide water through the pond for proper aeration and to help maintain proper water quality (Figure 5). Baffle levees are built about 6 feet wide at the base. They should extend a minimum of 6 inches above the expected water level for the pond. If the part of the baffle levees above the water line is not substantial enough, settling and erosion will cause the levees to breach in one or two years. Baffle levees should be spaced 150 to 300 feet apart to facilitate water circulation. Core trenches in the baffle levees are not necessary. A recirculation canal, outside the perimeter levee, and a re-lift pump or paddlewheel aerator will aid in water circulation and minimize water discharge (Figure 6).

Ponds designed to recirculate water are important in areas where the quality of the surface water supply fluctuates or where well water must be

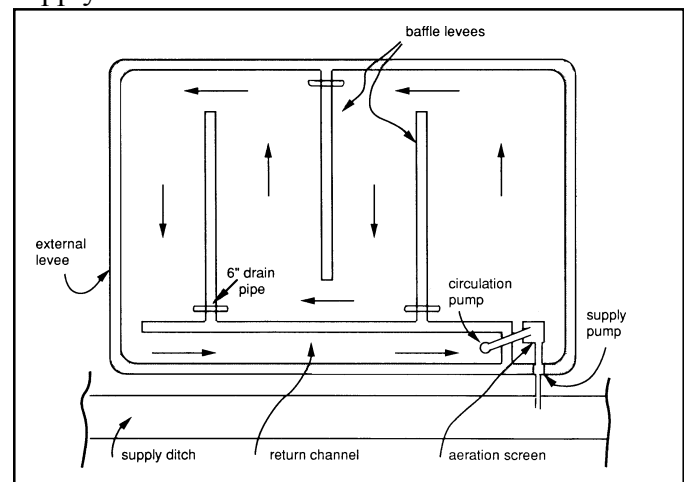


Figure 6. Construction plan for a crawfish pond showing a perimeter levee and baffle levees with recirculation capabilities.

pumped from great depths at great cost. Drains should be matched with the pond size, pumping capacity and projected rainfall. Two 10-inch drains are sufficient to drain a 20-acre pond. Ponds must allow vehicle access in wet and dry conditions and allow efficient use of harvesting equipment.

Best Management Practices

A set of Best Management Practices (BMPs) for crawfish production has been developed in cooperation with the Natural Resources Conservation Service (NRCS). These practices seek to minimize

erosion, reduce the amount of contaminants (nutrients and pesticides) in effluent discharges and maximize the benefit to wildlife. Implementing these practices in the coastal zone of Louisiana is emphasized.

A Best Management Practice consists of a Conservation Practice as defined by the NRCS and a description of how this practice can be conducted to have the least negative impact on the environment. The BMPs are summarized in Table 1.

Table 1. Summary of Best Management Practices for crawfish production.

Conservation Practice	NRCS Code	Rank	Comments
Access Road	560	A	Necessary for daily transportation to crawfish ponds for water management, forage management, harvesting and marketing crawfish. May impede natural runoff. May contribute to siltation if access road is not properly vegetated. May reduce wetland habitat.
Brush Management	314	B	May be required to plant forage and to develop harvesting lanes. Physical removal may cause temporary turbidity problems. Labeled use of herbicides would not have a significant environmental impact.
Channel Vegetation	322	B	Turbidity caused by unvegetated channels may contribute to sedimentation problems in crawfish ponds. Vegetated channels will help turbidity problems and improve water quality pumped into crawfish ponds.
Crop Residue Use	344	B	Natural vegetation may be allowed to grow before preparing for forage production to reduce erosion during interim of draining and planting forage. Provides habitat for wildlife. Cover improves soil moisture and should improve conditions for crawfish in burrows.
Filter strips	393	B	Provide a means of reducing sediment in inflow and discharge water where practical. May reduce soil erosion.
Fish Pond Management	399	A	Crawfish ponds used to produce crawfish commercially. Depth and forage production differ from typical fish ponds. Provides positive impact on the environment. Provides habitat for many forms of wildlife such as wading birds, waterfowl and many furbearers.
Irrigation field ditch management	388	A	Another effective irrigation tool which promotes good water management and conservation. Provides pathway for water from source to ponds.
Irrigation water management	449	A	Planned irrigation, flooding and draining to manage forage and crawfish.
Wells	643	A	Well water recommended over surface water.
Wetland development or restoration	657	A	Flooded crawfish ponds greatly benefit and improve the quality of the water entering and exiting the field in most cases. Crawfish ponds and production have a positive impact on environmental factors.
Wildlife wetland habitat management	644	A	Crawfish ponds provide over 115,000 acres of manmade wildlife wetland habitat that greatly benefits waterfowl, wading birds, gallinules, shorebirds, furbearers, reptiles, amphibians and numerous invertebrate animals that benefit other species of wildlife.

For more information about the application of BMPs, contact your local county agent or the area representative of the NRCS.



Developing Your Business Plan

Meticulous planning will increase your chance of business success. As with any enterprise, it's best to start small, learning and growing into an economically viable farming enterprise. When evaluating a crawfish farming business, consider these economic factors, requirements and questions.

1. Do you own or have access to property needed to raise crawfish? Does the property have a dependable water supply and adequate soils to construct ponds?

2. Do you own or have access to the necessary equipment (pumps, boats, traps, etc.)?

3. A realistic business plan should be developed with monthly objectives and projected cash flows for the first year and annually for each of the next three to five years.

4. Do you have access to capital for start-up and operation? Are your cost estimates and pricing projections reasonable? Do you have adequate cash reserves for equipment failure and other unforeseen problems?

5. Will your lender accommodate your production/marketing cycle? Can you afford to wait six to eight months for income until your first crop attains market size?

6. Have you identified your primary and alternative markets?

7. Are the estimated profits worth your labor and resources? Is the profit potential for crawfish farming competitive with other possible investments?

8. Are you willing to work long hard hours daily during the harvest season?

Marketing

Louisiana produces 90% of the crawfish in the United States and consumes 70% locally. Because of the demand for quality seafood, crawfish sales have increased both nationally and internationally. Development of whole, cooked, frozen crawfish and prepared frozen dishes has increased the distribution of processed crawfish.

An estimated 5% of the annual crawfish production (4 million to 5 million pounds) is exported to

European markets as a large, whole, cooked product. Exporting of whole, cooked crawfish involves large crawfish. The development of this market has had a major influence on the development of the grading system used.

Processed tailmeat is marketed in 1-pound packages either fresh or frozen. China has begun to export more frozen tailmeat to the United States in recent years. The low cost of the Chinese product has drastically lowered sales of domestic product. Processors heavily dependent on sales of tailmeat have been severely affected. Potential producers need to be aware of this problem and develop marketing schemes to reduce the influence of Chinese tailmeat on their operations.

All crawfish are marketed live by farmers. The farmer sells to a processor or a primary wholesaler. Some producers sell direct to retail stores, restaurants and consumers. Generally larger crawfish enter the live market, and smaller crawfish are processed. Producers of large crawfish can be more competitive with the fluctuations in price caused by the wild harvest. Producers of small crawfish are usually limited to selling to processors for the tailmeat market alone, and even this market is not guaranteed. Small crawfish are often rejected by the processor and the consumer.

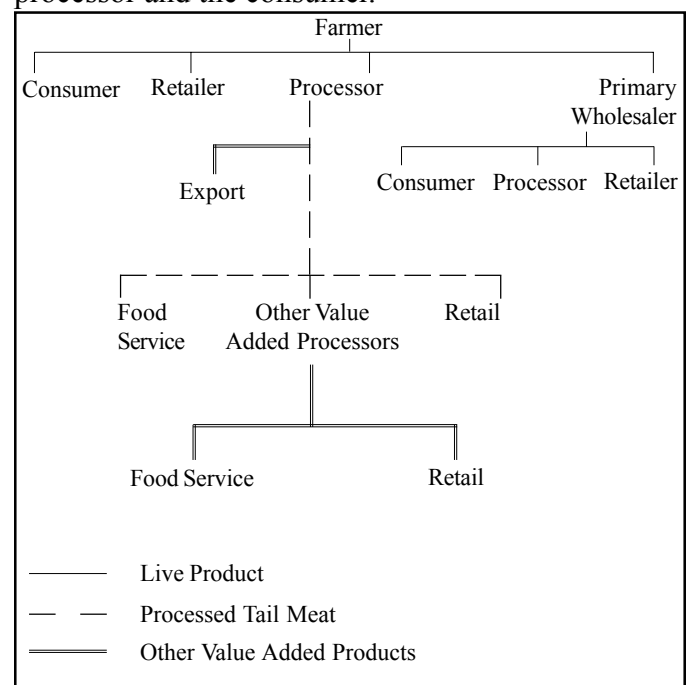


Figure 7. Marketing channels for farm-raised crawfish.

A crawfish producer should know the potential markets, both wholesale and retail, and match production to estimated needs. Identifying and establishing your markets should be your top priority. Before you get started, look into and evaluate all possible markets. Since crawfish are harvested several times per week, reliable buyers are paramount to a farmer's success. Remember, people will not be coming to your door to buy your product. You must sell your crawfish yourself.

Investment Requirements

The economic analysis of crawfish production has evolved as the crawfish industry has grown in technology, sales and complexity. Production cost estimates and knowledge about markets are essential. Abundance of wild crawfish has a depressing effect on prices when wild and farm-raised supplies overlap. A crawfish farmer must be aware of varying market conditions and how the market changes will affect the profitability of the operation.

A key to success is the understanding and estimation of production costs. Precise investment requirements, production and harvesting costs are not available for every farming situation. Projected

costs and break-even prices for permanent and rotational crop systems are shown on Table 2 and 3 respectively. They are based on a 1990 survey of 39 crawfish farmers with supplemental information provided by researchers and Extension Service personnel. The personal interview survey included production, harvesting and marketing practices.

Fixed costs for non-aerated systems were based on a 120-acre production unit consisting of six 20-acre ponds in two 60-acre units. Fixed costs for aerated systems were based on a 120-acre production unit consisting of six 20-acre ponds configured in three 40-acre units to facilitate servicing aerators and provide electrical service. An annual interest rate of 6.4% was assumed on the average annual investment in pond, well and specialized equipment. Harvesting was assumed performed by one person using a power boat with 20 traps per acre. The base yield level in Table 3 represents an optimistic production level for that production system. The last five columns in Table 3 illustrate what will happen to break-even prices when actual yields vary by 10%-20% above and below the base yield level.

Table 2. Summary of projected costs for crawfish and crawfish-rice production in Louisiana, 1996. ¹

Crop Description	Yield Per Acre Pounds	Direct Expenses			Fixed Expenses			Total Expenses		
		- - - - - Dollars per Acre - - - - -								
Crawfish Enterprises:										
Northeast Louisiana										
Non-aerated, Owner ³	600	214			124			337		
Southwest Louisiana										
Non-aerated, Owner ³	1,200	268			132			401		
Gasoline recirculating, Owner ³	1,200	315			178			493		
Electric recirculating, Owner ³	1,200	303			176			478		
Crawfish-Rice, Owner ^{2,3,4}	900+4200	500			127			626		

¹ Boucher and Gillespie, 1996.

² Income for rice was calculated by multiplying the market price of \$8.50 by actual yield.

³ Land costs are not included.

⁴ Yield includes 900 lbs of crawfish and 4,200 lbs of rice.

Table 3. Total costs and break-even prices for various crawfish yields, Louisiana, 1996.

	Total Costs ² <i>Dollar/Acre</i>	Total Variable Costs	Base Yield Level <i>lb.</i>	Yield Value				
				-20%	-10%	Base	10%	20%
				<i>Price or Avg. Cost Dollars/Lb.</i>				
PRICES REQUIRED TO RECOVER								
TOTAL SPECIFIED COSTS								
Crawfish Enterprises:								
Northeast Louisiana								
Non-aerated, Owner	337		600	0.7	0.62	0.56	0.51	0.47
Southwest Louisiana								
Non-aerated, Owner	401		1,200	0.42	0.37	0.33	0.3	0.28
Gasoline recirculating, Owner	493		1,200	0.51	0.45	0.41	0.37	0.34
Electric recirculating, Owner	478		1,200	0.49	0.44	0.39	0.36	0.33
Crawfish-Rice, Owner ³	233		900	0.3	0.27	0.24	0.22	0.2
PRICES REQUIRED TO RECOVER								
VARIABLE COSTS								
Crawfish Enterprises:								
Northeast Louisiana								
Non-aerated, Owner		214	600	0.44	0.39	0.35	0.32	0.29
Southwest Louisiana								
Non-aerated, Owner		268	1,200	0.28	0.25	0.22	0.2	0.19
Gasoline Recirculating, Owner		315	1,200	0.33	0.29	0.26	0.24	0.22
Electric recirculating, Owner		303	1,200	0.31	0.28	0.25	0.23	0.21
Crawfish-Rice, Owner ³		190	900	0.24	0.21	0.19	0.18	0.16

¹ Boucher and Gillespie, 1996.

² Land costs are not included.

³ Break-even selling prices for crawfish in rotation with rice represent the net cost of producing crawfish in the rotation situation compared to producing rice alone.

The tables indicate that a crawfish farmer has many considerations. A prospective grower faces different costs by area and type of system used. Farmers who are producing rice are in the best position to start crawfish production and also have more exit options. Break-even costs are much higher in northeast Louisiana because yields are

generally lower. Even in the more productive area of southwest Louisiana, there is need for caution. The projected 1200 pounds per acre yield in Tables 2 and 3 reflects optimism. On average, yields are often lower.

Record Keeping

A record keeping system is needed to generate financial reports and production records. The basic purposes of records are reporting, control, evaluation and planning.

Financial reports that give the manager vital information about the business are the most important function in record keeping. Through the financial statements, the manager can determine profits (or losses), the feasibility of the business plan, the accumulation of net worth in the business and the profitability of each part of the business. The financial reports consist of Income Statements, Balance Sheets, Cashflow Statements and Enterprise Reports.

The Income Statement measures the business's profits over a specific period. This statement lists the expenses that occurred during the accounting period and the income generated.

The Balance Sheet is a complete listing of the assets (what you have) and liabilities (what you owe) of the business. The difference between your assets and your debts is your net worth or equity.

The Cashflow Statement measures all of the cash coming into the business and all of the cash going out. It is a measure of the ability of the business to pay its bills as they come due.

Enterprise Reports detail the expenses incurred and the incomes generated by those expenses for each of the commodities produced. In short, an enterprise report is an income statement for a commodity. By looking at the profits for each commodity, the manager can decide what to produce and how much.

The control and evaluation functions of a records system allow the manager to see what is going on in the business, decide what is working and what is simply costing too much. Evaluation during the year is critical to keeping costs as low as possible while pushing income up. Often producers don't know how much has been spent in total or by item and therefore cannot stop wasteful practices.

Financial planning for the coming year is needed to decide if sufficient net income will be generated to meet business goals. As prices paid and received change, the ability to pay bills on time and service debt can change. A projected cashflow will show the feasibility of the proposed business plan.

Production records and reports contain information about the technology used in production. It's important to maintain records of pumping time, traps used, bait (type and amount), water quality information, crawfish production time (hours, labor), results of grading and sales income per acre and per day. Careful analysis will identify the strengths and weaknesses of the production process. Future management decisions concerning forage, water, population dynamics, harvesting strategies and marketing are easier and more accurate if good records are kept. Correction of problem areas results in increased production efficiency. Also when a crop is lost because of a natural disaster or pollution, records are needed to prove losses.

Records can be kept either in handwritten ledgers or by computers. Either method takes about the same amount of time to record information. The Louisiana Cooperative Extension Service has three publications that can be used to form a basis for your own system. The publications are the Louisiana Fisherman's and Trapper's Record Keeping Book, Pub. 1983, the Louisiana Farm Record Book, Pub. 1291, and the Louisiana Farm Inventory Record, Pub. 1849.

Computer technology allows reports to be prepared easily and much quicker, however. Computer record systems should be given careful consideration when choosing a record keeping system. The most popular examples are Quicken™, Quickbooks™ and MS Money™. More experienced computer users can use spreadsheet programs such as Lotus 123™, Excel™ and QuatroPro™.

Contact your county agent for more information about financial planning for farming operations.



Water Supply

Both surface and subsurface water are acceptable for crawfish farming. Wells provide predator-free water, but they have a limited discharge capacity, higher pumping costs and must be oxygenated. Well water often contains soluble iron and hydrogen sulfide that must be removed before water enters the pond. Surface water is desirable if it is pollution free and nuisance fish can be screened out. While cheaper to pump, surface water may not be reliable in quantity and quality.

Pumps, motors and pipes must be matched to obtain the most efficient performance. Lift should be minimized as much as possible to reduce pumping costs. Surface water contains predator fish that can be removed through a 1/2 inch mesh aeration screen. Smaller fish passing through the 1/2 mesh aeration screen need not be removed, because they don't pose a predation problem to young crawfish. These fish are killed when the pond is drained in summer. If pools or puddles persist, treat them with a fish toxicant.

Quantity of Water

The quantity of available water is often a limiting factor in crawfish culture. A pumping capacity of 70 to 100 gallons per minute per surface acre is recommended for intensive management strategies. This rate is needed to exchange all the water in the pond over a four- to five-day period, especially in the early fall when water is flooded onto vegetation. Warm weather leads to rapid plant decay and high demand for oxygen. Recirculating and/or flushing the pond with fresh, oxygenated water maintains satisfactory water quality. Water needs and low oxygen problems can be reduced by adding 4 to 6 inches initially rather than the full 8- to 12-inch level.

A pond with dense vegetation may need seven to nine water exchanges per season to maintain good water quality. If poor quality water is discharged, total water usage for the season can be as high as 10 to 16 acre feet of water per surface acre of pond. The use of water recirculation systems can reduce water usage to 3 acre feet of water per surface acre of pond.

Water Quality

Water quality depends on properly designed and constructed ponds that have a dependable water supply. Important water quality variables are dissolved oxygen, pH, total hardness, total alkalinity, ammonia, nitrite, iron, hydrogen sulfide content and salinity.

Dissolved oxygen (DO) is the most important. Temperature has a major effect on oxygen levels in ponds. Warm water cannot hold as much oxygen as cold water. Also, rising water temperature increases biological activity, so oxygen is consumed at a faster rate. When the water temperature increases from 70 to 80 degrees F, the rate of oxygen loss caused by decomposition doubles. Potential problems with insufficient oxygen can be expected whenever water temperature exceeds 65 degrees F. During warm periods, ponds with an inadequate pumping capacity and excessive amounts of decaying vegetation will suffer from severe oxygen depletion.

Low dissolved oxygen is a serious problem in crawfish farming. The first two to six weeks after initial flood-up is the most critical time. Dissolved oxygen should be maintained above 3 parts per million (ppm) for optimal crawfish production. When oxygen levels drop below 2 ppm, crawfish stop feeding and they can become predisposed to disease. As oxygen levels drop to 1 ppm, newly hatched juveniles and molting crawfish begin to die. Crawfish stressed by low dissolved oxygen climb to the surface expose their gills to higher dissolved oxygen at the surface.

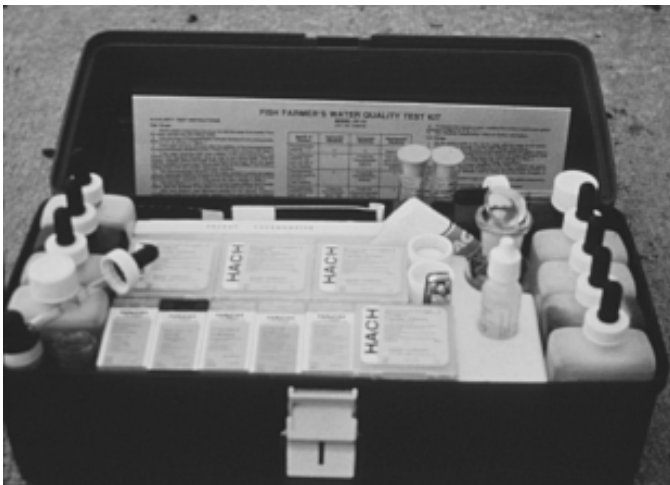
There are several different ways to check dissolved oxygen in a pond. Dissolved oxygen meters are best if you have many ponds to check. Most producers, however, choose oxygen test kits because they are relatively inexpensive and simple to operate. The easiest kit uses a vacuum ampule that draws in a water sample. The value is determined by matching the color of the sample to a chart.

Dissolved oxygen should be measured regularly, especially during warm and cloudy weather. Dissolved oxygen levels are lowest early in the morn-





Oxygen meter



Water quality test kit

ing, so this is when you should check. The first sample should be taken where oxygenated water is added to the pond. Take the water sample taken half way between the surface of the water and the pond bottom. Also check at two additional locations in the pond, preferably in one area of good water circulation and one area farthest away from the pump. The general rule is if oxygen levels are 3 ppm or more at dawn, the water quality is good. If levels are between 1 and 3 ppm, crawfish may be stressed and corrective action should be started.

Oxygen deficiency is corrected by replacing pond water with fresh, oxygenated water or by recirculating water with pumps or mechanical aerators. Pumping water through an aeration tower divides the water into small droplets. This gives maximum oxygen transfer to the water droplets. Well water can also be aerated by exposing it to the atmosphere as the water travels through flume



Aeration screen used on pump discharges ditches.

The water pH should range from 6.5 to 7.5 at dawn, and both total hardness and total alkalinity should range between 50 to 250 ppm as calcium carbonate. If the pH, hardness and alkalinity are low, incorporate agricultural limestone into the pond bottom during the next dry cycle.

Un-ionized ammonia and nitrite are toxic to crawfish at concentrations exceeding 2 and 4 ppm (as nitrogen), respectively. Concentrations this high are not likely to occur in crawfish ponds because the crawfish production intensity is low and ammonia is rapidly taken up by aquatic plants. Iron and hydrogen sulfide are toxic to crawfish at concentrations often found in subsurface well water; but the two compounds are lowered to non-harmful concentrations when well water is oxygenated. Where iron and hydrogen sulfide concentrations are high, it may be necessary to place a flume ditch or pond between the well and the crawfish pond to allow the iron to precipitate.

Crawfish farmers in coastal regions should monitor tidal influenced surface waters during a drought. Tolerance to salinity is directly proportional to crawfish size. Newly hatched young die at 15 parts per thousand (ppt) and juveniles die at 30 ppt if kept in this salinity for a week. Adult crawfish can tolerate salinities up to 35 ppt (sea water) for a short time, but spawning is affected at 12-15 ppt. Salinity also affects vegetation at much lower concentrations. Crawfish ponds should probably

not be located where salinities higher than 5-10 ppt are likely to occur.

Recirculation

Aerated water must be transported through the pond to reach all the crawfish to achieve maximum survival, growth and yield. As stated, it is important to match pumps and transport systems (pipes, canals or ditches) to maximize energy efficiency. Water is guided through the pond by a series of small internal baffle levees which direct the flow of water throughout all areas of the pond. Recirculation of the water within the pond can be done with aeration devices like those used in catfish ponds. Mechanical paddlewheel aerators, 1/4 - 1/3 of less horsepower per surface acre, can be used to aerate and circulate the crawfish pond water with more cost effectiveness than water replacement by pumping.

Paddlewheel aerators are very effective. A 5 hp paddle wheel moves and aerates 6,000 gallons of water per minute, enough to recirculate water through a 40 to 50 acre pond in less than three days. Recirculating pond water with paddle wheel aerators is economical.

These aerators operate at an efficiency of 4 to 5 pounds of oxygen per horsepower-hour as compared to aeration screen systems that have an efficiency of adding 1 to 2 pounds of oxygen to the water per horsepower hour. Recirculation of water with paddle wheel aerators conserves energy and water. Hourly energy costs are reduced by 50%-70% with the proper installation of aeration/circulation devices. Using these energy-efficient aerators allows longer periods of aeration, improves water quality and increases production.

Pond location and local energy costs dictate the type of pump and power source used for crawfish ponds. Production of crawfish by standard methods (pumping and flushing) is energy intensive. The pumping costs range from \$40 to \$150 per acre per year in typical systems that pump from surface

sources. Higher costs are associated with pumping from wells.

In a natural ecosystem, crawfish eat a variety of plants and animals. Crawfish prefer to feed predominantly on aquatic invertebrates but will feed on detritus and intact vegetation. Detritus is pieces of decomposing organic material which becomes the

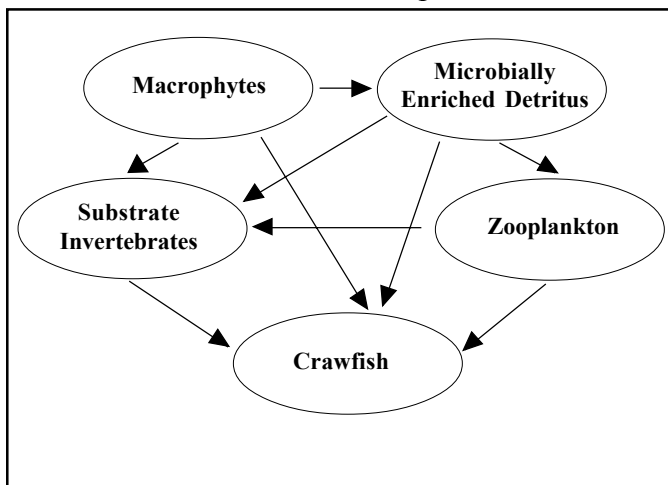


Forages



fuel that drives the vegetative-based production system.

Crawfish use little of the live green plant material. The main role of green vegetation is to furnish the material for decay which becomes detritus. As organic matter decomposes, it becomes “coated” with bacteria, other microorganisms, and small animals like insects that increase its nutritional quality. Small aquatic animals such as insects, worms, clams, snails and zooplankton also feed on the decomposing vegetation. There is increasing evidence that these animals and plant seeds also



furnish significant nutrition for crawfish growth.

Figure 8. Food chain of crawfish.

Crawfish farming requires forage that provides material to the underwater food web consistently throughout the growing season. Many aquatic plants perform this task poorly, but they can provide substrate and cover for other organisms that serve as food for crawfish. Some aquatic plants do not grow consistently enough to provide adequate forage for crawfish year after year. One year a specific plant may flourish, and the next it may be nonexistent.

Premature depletion of forage can be a limiting factor for many crawfish farmers. It’s important for the forage to continually and consistently provide adequate amounts of material to the detritus system for the duration of the nine-month production season. The time of planting and plant variety can significantly influence the availability of the forage over that period.

Two basic forage systems are used for crawfish production. These are (1) use of planted and cultivated forage crops and (2) use of voluntary natural vegetation.

Cultivated Forages

Cultivated forages provide a controlled detrital-based system that results in good crawfish yields. Planting a cultivated agronomic crop is the most dependable method of providing suitable crawfish forage. It allows farmers to control the type and amount of available forage. Forage density is more predictable with an agronomic crop because cultural practices are well established.

The preferred forage to plant for crawfish is rice (*Oryza sativa*). Rice is grown for forage in most crawfish ponds in Louisiana. Rice has less of an negative impact on water quality than terrestrial plants because of its semi-aquatic nature and resistance to lodging. Rice can be planted for grain production with the post-harvest residue (stubble) and re-growth (ratoon) serving as crawfish forage, or it can be planted solely as a crawfish forage.

Factors to consider in rice variety selection include culture system (rotational or single cropping), forage biomass, lodging characteristics and rice re-growth (ratoon) potential. Currently recommended rice varieties in Louisiana by grain type and maturity group are in Table 4.

Table 4. Recommended rice varieties for crawfish production in Louisiana.

Grain Type	Maturity	Production System	
		Rice/Crawfish Rotation	Single Crop Crawfish
Long	Very Early	Jackson	
Long	Very Early	Maybelle	
Long	Early	Cypress	Cypress
Long	Early	Drew	
Long	Early	Gulfmont	
Long	Early	Kaybonnet	Kaybonnet
Long	Early	Lemont	
Medium	-	Bengal	Bengal
Medium	-		Orion

Medium	-	Lafitte	Lafitte
Medium	-	Mars	Mars
Medium	-		Rico

Rice for Grain and Forage

Proper cultivation of rice requires adequate soil preparation, good planting techniques, water management and fertilization. A discussion of the cultivation practices required to optimize rice grain production is beyond the scope of this publication. For more information on rice production, contact your county agent and ask for this LSU Agricultural Center publication: *Rice Varieties and Management Tips*, Pub. 2270.

Most rice farmers in Louisiana plant in late March to late April, with varieties requiring about 120 days for grain maturity. Grain production is a function of the number of days required for heading, the planting date, temperature and photoperiod (length of daylight).

When harvesting grain, you can use a straw chopper on the rice combine to chop up the excess straw. These smaller pieces will decompose during the weeks before reflooding the ponds. If the combine is not equipped with a chopper, remove or disengage the spreader bars and allow the straw to fall directly behind the combine. If excessive straw is present, bailing the straw will enhance stubble regrowth and decrease water quality problems after flood-up.

The food supply for crawfish can be greatly increased by encouraging regrowth of rice stubble after the grain has been harvested. A light application of nitrogen (20-30 lbs of nitrogen/acre) can be applied immediately after the grain is harvested. The field should then be flushed if adequate moisture is not available. While holding more than 2-3 inches of water for more than 48 hours is not recommended, timely flushing of the field will prevent the loss of nitrogen and encourage rapid stubble regrowth.

Rice for Forage

It is often desirable to grow a stand of rice as forage only. Such a rice variety should produce high vegetative biomass, be resistant to lodging,

senesce slowly and persist throughout the crawfish production season. Also consider disease resistance, especially in late plantings.

This rice is normally planted from mid-July to early August. Planting rice as forage for crawfish at this time can cause a 50% reduction in total biomass. This results in good water quality, however, because the amount of decomposing straw is reduced at the time of fall flooding. Rice planted in August usually does not reach maturity, therefore senescence is delayed, and as a result its persistence may be better. Because extremely hot conditions can be encountered during this period, stand establishment is often difficult. Standing water on seedling rice during hot weather can kill the young plants by scalding. You must be prepared to remove all standing water from the young rice quickly.

It is desirable to cultivate a dry seedbed. A well-prepared seedbed will facilitate stand establishment if the rice is to be dry-seeded (either drilled or dry broadcast). Seeding rates of 75-90 lbs/acre for drill seeded rice and 90-120 lbs/acre dry broadcast seeded rice provide adequate vegetation. Harrowing after dry broadcasting may be desirable to cover the seed. If rain is not received within 3-4 days after planting, it may be necessary to flush the field (flood and drain quickly) to ensure adequate moisture for germination.

When water seeding, it may be beneficial to leave the seedbed somewhat cloddy. This will minimize seed drift, often be a problem in water-seeded rice. The seedbed should not be left so cloddy that excessive weedy vegetation remains alive because these weeds will compete with the rice seedlings and lead to stand establishment difficulties.

Flood the field one to two days before seeding. Recommended seeding rates for water seeding are 90-120 lbs/acre. If pre-sprouted seed is used, the field can be drained immediately after seeding in most cases. If dry seed is used, it is necessary to hold the flood for one day. This allows time for the seed to take in adequate moisture for germination. It is necessary to drain the field in either case and



beneficial to drain low areas to make sure all pockets of water are removed to guard against scalding. It may also be necessary to flush the field to provide moisture within 7-10 days and periodically thereafter to maintain good soil moisture for optimum rice growth. These flushings should not last more than two to three days. Long flooding periods may encourage crawfish to emerge from their burrows and increase the possibility of losing young crawfish.

Even when rice is not grown for grain, it is necessary to provide fertilizer to assure good growth and development. Normally, about 60-80 lbs of nitrogen and 30 lbs of both phosphorus (P) and potassium (K) per acre are adequate with this system. On heavy clay river bottom soils, the P and K may not be necessary. A soil test is recommended for determining P and K needs. The fertilizer can be broadcast just before planting or applied just before one of the periodic flushes as the plants develop two to three weeks after seedling emergence.

Sorghum-sudangrass

Although the Louisiana crawfish industry does not have much experience with sorghum-sudangrass



Stand of sorghum-sudangrass after flood-up

hybrid (*Sorghum bicolor*) as a crawfish forage, satisfactory results have been achieved in commercial plantings. Sorghum-sudangrass seed can be obtained from most farm suppliers and seed dealers. Sorghum-sudangrass grows rapidly, produces larger

quantities of vegetative matter, is drought resistant and may prove more reliable for late summer stand establishment. Sorghum-sudangrass tends to persist longer than rice in flooded crawfish ponds. This results in more forage during the latter part of the crawfish growing season.

Sorghum-sudangrass should be used only in ponds where a forage is to be planted in late summer solely for crawfish. Because of its growth potential, target planting dates should be early August through early September. Planting should not be postponed too long, since cooler weather and the shorter days of early fall may inhibit plant establishment and growth.

Earlier planting will result in very tall, mature plants at flooding. If planted early, vegetation should be cut to a 1- to 2-inch stubble in early to mid-August to allow for regrowth. The harvested sorghum-sudangrass can be baled and left in the pond. Also if planted too early sorghum-sudangrass is likely to reach physiological maturity before flood-up and can be detrimental to water quality when plants lodge or large numbers of leaves sluff off into the water.

Sorghum-sudangrass can be drilled or broadcast, but drilling is preferred and less risky. If drilled, a smooth, well-prepared seedbed is desirable, and seeding depth should be 1/2 to 1 inch, depending on soil moisture. Optimum germination temperature is 70-85 F, and care should be taken to assure that adequate soil moisture is available. Seeding rate should be 20-25 lbs/acre to produce good crawfish forage.

If drilling is not practical, broadcast the seed into a rough seedbed at the rate of 25-30 lbs/acre and then cover lightly with harrow or similar equipment. It is important that seed be adequately covered to reduce the chance of being eaten by birds or seed loss caused by runoff if rain occurs before

germination. Whether drilled or broadcast, the key factor is adequate soil moisture for germination, since the seedlings are fairly drought tolerant once they are established.

Fertilizers can significantly increase growth and the vegetative biomass of sorghum-sudangrass. Follow the Cooperative Extension Service fertilizer recommendations for sorghum-sudangrass in your parish. In some fertile soils, no additional fertilizer will be necessary, but the only way to know for sure is with a soil test. The sorghum hybrids are typically sensitive to low soil pH, but no problems have been observed with soils that average a pH as low as 5.5.

It may be desirable to mow trapping lanes in the pond just before flooding in the fall, especially if sorghum-sudangrass was planted early. Tall plants restrict vision from a boat during early season harvest. In most cases, however, trapping lanes can be established by running the boat through the pond a few times, knocking the plants over.

Pesticide Toxicity

Four approved herbicides are labeled for use in crawfish ponds. They are Stam®, Basagran®, 2,4-D and Rodeo®. If Stam® is not sprayed evenly across the field and exceeds 1 lb active ingredient/acre in any part of a field, damage to crawfish may result. Of all the insecticides, only Malathion® and Bt® (biological insecticide, *Bacillus thuringiensis*) compounds are labeled for use in crawfish ponds. No fungicides are labeled for use in crawfish ponds or in fields intended to be used as crawfish ponds.

Be sure to read the label of any chemical or compound before using it in or near crawfish ponds. Crawfish are very sensitive to most chemicals and, as a result of carelessness, production can be eliminated in a short period. Always be safe and read the label. Contact your county agent about the use of any pesticides.

Natural Vegetation

When flooded, voluntary terrestrial grasses and sedges usually decompose rapidly. This reduces

water quality and provides short-lived detrital sources. Aquatic and semi-aquatic plants such as alligatorweed (*Alternanthera philoxeroides*) and smartweed (*Polygonium* spp.) are superior to terrestrial grasses because they continue to live when flooded. But, like terrestrial grasses, the aquatic plants may not supply sufficient food to sustain high crawfish yields. Alligatorweed may cover an entire pond, providing high biomass, but crawfish growth is unpredictable because much of the plant material is above the water and not available to the food web.

Mats of living aquatic plants may also make it difficult to set crawfish traps and maneuver a harvesting boat. They can also impede water circulation and slow the warming of water by blocking sunlight. During some years, the alligatorweed flea beetle (*Agasicles hygrophila*) may devastate entire stands of alligatorweed, reducing the food resource. Despite these obstacles, ponds that have a mixture of natural aquatic plant types do occasionally produce good crawfish crops.

The three major disadvantages of using natural vegetation are (1) stand density varies with location, time of year and is unpredictable from one year to the next, (2) cultural practices for natural plant species are not well understood and (3) many natural plants are considered noxious weeds and are unwanted where agronomic crops will be grown in



Management Considerations



subsequent years.

The advantages of using natural vegetation are (1) there are no costs associated with planting and (2) there can be reduced pumping costs in some instances with alligatorweed ponds.

Stocking

New ponds should be stocked with red swamp crawfish broodstock beginning April 15 at a rate of 50-60 pounds of sexually mature crawfish per acre. Stocking later can be more difficult because the supply of broodstock is less certain. Mature pond crawfish should be stocked within 2 to 3 hours after capture. Avoid using crawfish that have been stored in a cooler because mortality can be high. Broodstock should be transported in a covered vehicle to avoid exposure to wind and sunlight. Stocking white river crawfish is strongly discouraged.

The sex ratio should be close to 50% males and 50% females. Size of broodstock has no impact on the size of the young crawfish produced. When crawfish ponds are initially stocked in the spring, the ovaries (located in the head) of females should be checked to determine their stage of maturity. Ideally, about 20% of females should have tan to darker colored eggs.

Crawfish should be stocked in pond water adjacent to baffle or perimeter levees. When stocking a new pond without forage, encourage burrowing by spreading hay along the edge of the pond to provide cover for burrowing and escapement from predators. After an acclimation period of one to two weeks, drain water slowly over three to four weeks to stimulate the crawfish to burrow.

There are usually adequate mature crawfish remaining after a production season to supply juveniles for the next season. Restocking is usually not necessary in permanent ponds or when the physical location of the pond does not change.

Timing of Pond Flood-up

Ponds should not be flooded until the daytime high air temperatures average in the low 80° F range and the nighttime lows average 65-70° F,

usually by mid-October in south Louisiana. Flooding into green rice or sorghum-sudangrass before October 1 may be possible by paying close attention to oxygen levels and taking corrective action when necessary. An early flood in harvested rice fields or naturally vegetated ponds with terrestrial grasses is very risky because of the amount of organic matter present. It's better to flood a little later with the possibility of having late crawfish than flooding early and losing the young crawfish because of low oxygen conditions.

It is not necessary to put the full amount of water in a pond (8-12 inches in rice-crawfish rotation ponds or 18-22 inches in permanent ponds) during the initial flood-up unless birds or other predators are a problem. Four to 6 inches of water is usually sufficient. Less water in the pond reduces pumping and water changes, and there is less water to aerate and replace. Also, less vegetation is exposed to the water column, reducing the amount of decomposition. About seven to 10 days after the initial flood, if indicated by low oxygen determinations, it may be necessary to flush or replace the pond water. To flush a pond, drain it down to 3 inches before pumping unless predators are a problem. The fresh aerated water will flow through the pond, pushing the bad water out the overflow. Results are better if ponds are constructed with interior baffle levees. Ponds should be flushed every seven to 10 days or as indicated necessary by low oxygen levels until temperatures fall below 65° F and oxygen levels stabilize. When oxygen levels increase with cooler air, the water level should be gradually brought up to full depth, generally by early to mid-December.

Estimating Potential Yield

Crawfish population growth and numbers should be monitored beginning no later than 45 days after flooding and continuing until eight to 10 weeks after flooding. These procedures can be used to estimate the **potential** yields that could be produced if conditions remain optimal. These estimates are based on years of observations in many crawfish ponds, but they have little research documentation. Use them only for comparisons between fields and

as a way to monitor the recruitment of young crawfish into the population.

1. Drag a sturdy, small-mesh dip net rapidly across the bottom of the pond. Dip in several different areas in the pond.
2. Count the number of crawfish per dip, note the different sizes (0.5, 1, 2 inches or larger) and determine the number of crawfish in each size group caught per dip. If no crawfish are caught during the day, try at night when they are most active.
3. Eight or more crawfish per dip with five to six groups of different sizes usually suggests the potential for high yields (1000-1500 pounds per acre). This type of recruitment can also lead to overpopulation and stunting.
4. Four to seven crawfish per dip with four to five groups of different sizes indicates the potential for good yields (800-1000 pounds per acre).



Sampling with dip net

5. Two or three crawfish per dip with three to four groups of different sizes may yield 600-800 pounds per acre.
6. Catching one per dip with three different groups should yield 400-500 pounds per acre.
7. One small crawfish every other dip with one or two groups indicates significant mortality. Do not expect more than 100-200 lbs. per acre.

Supplemental Feeding

Despite the farmers' best plans, desirable forage

usually disappears before the season is over. Some research indicates supplemental feeding of pelleted feeds can increase crawfish yields and size; others show no benefits. In most studies, marginal increases in yield and size don't compensate for feed cost.

Hay is often used to supplement the food base in crawfish ponds. For hay to be effective, it must be distributed over the pond. The bales, whether square or round, should be broken up and put out regularly, but not in quantities that encourage water quality problems. Hay should be used as a supplement only. When hay is the primary food source, the amount required for optimum crawfish production is about 7000 pounds per acre (dry weight) distributed in many applications. This procedure may be only marginally effective and is seldom cost effective. Also the logistics of obtaining, hauling and distribution of hay may not be practical.

Other options are the addition of agricultural products such as whole grains or soybeans. No reliable supplemental feeding program exists. This emphasizes the importance of establishing a forage base during the summer.

Managing for Larger Crawfish

The two most critical production problems facing the Louisiana crawfish industry are complete crop failure and the overproduction of stunted, low value crawfish. Crop failure is the result of too few crawfish, often resulting from poor recruitment or low survival of juveniles. Harvests of small, stunted crawfish are usually the result of too high a density of crawfish. Stunting refers to the situation where crawfish simply stop growing before they reach a minimum harvestable size or desirable market size. This minimum size is usually 22-23 crawfish per pound or between 3 to 3.5 inches.

The major factors affecting crawfish growth are harvesting strategy, certain water quality conditions, food availability and food quality, genetic influences, population density or combinations of these factors. Harvesting strategy, water quality and food sources are generally manageable. Research indi-

cates that genetics and breeding programs show little potential for improving harvest size. The most important factor in the production of large crawfish is density. High density (more than 15/square yard) of crawfish produces small crawfish, and low densities produce large crawfish if food and water quality are adequate. With the current state of technology, density control is difficult. An active research program is under way to provide solutions.

Methods to minimize stunting of crawfish in subsequent seasons are based on preventive measures taken during the current season. These include rotating production into different fields, delaying flooding in the fall and draining the pond quickly in mid-spring.

Rotating production into different fields or letting a permanent pond remain temporarily drained after several consecutive years can be effective, but loss of production in ponds for an entire season could lead to lost revenue that could outweigh the benefits of density control.

Delaying the permanent flood in the fall could reduce survival of juveniles in the burrow. Although this could delay the peak of production, it can sometimes be an effective control because it potentially reduces the total number of recruitment classes. If there is a long, cool spring or ponds become low in forage, many late crawfish may not have enough time to reach harvestable size before the ponds are drained.

Another method has been draining the ponds earlier than normal, before too many crawfish become sexually mature, and draining the ponds quickly, stranding numerous crawfish before they have the opportunity to burrow. This method is not always effective in older ponds with many established burrows. There can also be a loss in income when the harvest is stopped early to drain the ponds.

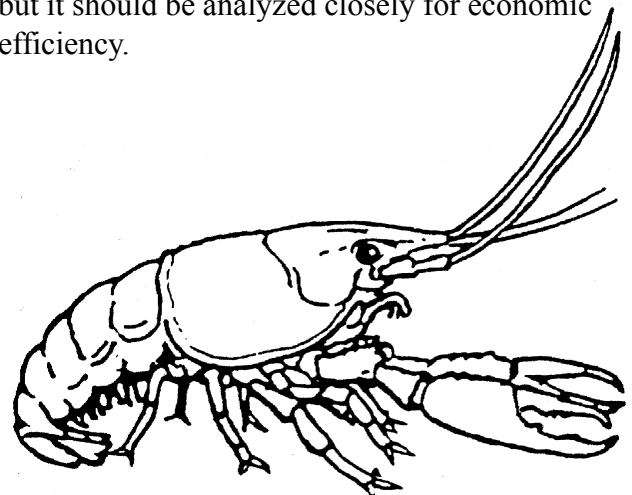
Management practices that would yield predictable results within the same production system are lacking. Current practices being evaluated by researchers include: mid-season temporary draining, maximizing the use of forages, modifying the

harvesting schedule and relaying.

Reduction of crawfish densities at mid-season is effective in some cases. To maximize effectiveness, the reduction must occur after peak recruitment of juveniles but before ponds warm to near optimal temperatures in the spring. If reduction occurs before the numbers of juveniles peak, too many will survive and stunting will occur. Reductions too late in the spring will not allow the crawfish that survive to grow to harvestable size.

Modifying the typical harvesting routine also shows a potential for producing larger crawfish. Trapping five to six days a week can reduce the average harvest size of crawfish because animals are removed before they can grow to a more desirable market size. Harvesting three days a week increases overall catch size, but the total yield is usually lower. The effectiveness of this reduction strategy will depend on population density and size structure, food availability, time of year, trap density and marketing conditions.

Relaying or transferring crawfish from a poor environment to an improved environment is highly effective in increasing crawfish size. Since crawfish and rice seasons overlap, it is common to have newly established rice fields at a time when crawfish stunting normally occurs in forage-limited crawfish ponds. This provides the opportunity of using the vegetative growth phase of rice production as a valuable resource for obtaining additional growth. This method can be biologically effective, but it should be analyzed closely for economic efficiency.





Researchers have made it a high priority to evaluate these and other practices designed to prevent or correct stunting problems and refine their effectiveness and economic feasibility. Once you suspect you have a stunted population, ask your local aquaculture or fisheries agent to help you evaluate your options.

Harvesting crawfish is labor intensive and typically accounts for two-thirds of production costs. In well-managed ponds, crawfish are generally harvested over 90 to 120 days per production season (November-June). If there is a poor fall and winter recruitment, harvest may be restricted to March-May (45 to 60 days). In well-managed ponds about one-third of the crawfish are harvested from November-February, one-third from March-April and the remainder in May-June. In field rotation systems, the bulk of the harvest occurs after mid-February.

Bait



Whole gizzard shad must be cut into smaller pieces

Two types of bait are used in the crawfish fisheries in Louisiana - natural baits and manufactured or formulated baits. Natural baits include various species of fishes. Manufactured baits are made from fishmeal, fish solubles, cereal grains and

grain by-products, attractants and binders. These baits may be used separately or in combination with natural baits.

Natural Baits. Gizzard shad is the most important natural bait, but significant quantities of menhaden (pogy), herrings (slicker), carp, suckers, mullet, and the heads and viscera of processed fish are also used. The primary advantage of fish baits is that they are significantly more effective in cold water (below 65° F) than manufactured baits. High quality bait fishes such as shad or menhaden are generally several times more effective than manufactured bait at temperatures lower than 50° F (January-February), and at least twice as effective as



Cubes of manufactured bait
manufactured baits at 50° to 60° F (November-December, March-April). Fishes that have been in frozen storage for long periods are significantly less effective than fresh fish baits. Fish baits have several disadvantages - supply and price are seasonal, freezers are required for storage, they are generally more expensive than manufactured baits, labor is required to cut the bait and fish generally has an unpleasant odor.

Manufactured Baits. Several feed companies market manufactured crawfish bait in Louisiana. Manufactured baits are cylindrical pellets, 1 to 3 inches diameter and 3 to 4 inches long, that weigh 0.15 to 0.25 pounds each. Manufactured crawfish baits are as effective, or more effective, than fish at temperatures of 60° F or higher (mid-March through May). Manufactured baits are less effective in winter.



Many crawfish trappers put manufactured bait and fish in the same trap together to increase catch. At water temperatures of 60° to 68° F (November-December, March-April), a combination of manufactured bait and fish has been shown to increase catch as much as one-third than either the same manufactured bait or fish when used alone. Manufactured baits are the preferred bait when water temperatures are 69° F or higher.

Table 5. Suggested bait selection based on water temperature.

<i>Temperature</i>	<i>Suggested Bait</i>
50 - 59° F	Fish
60 - 68° F	Fish/Manufactured Combination
69° F and higher	Manufactured

Bait Cost. Bait costs vary, depending on the type of bait used and seasonal supply, but generally range from \$14 to \$27 per 100-pound units. Total annual bait cost depends on the type of bait used, the quantity used per trap, the number of traps and the frequency of trap lifts (days per season and trap sets per day). Bait accounts for 38% to 61% of total harvest costs and 10% to 32% of total direct costs to crawfish farmers.

On average, bait cost will range from \$0.05 - \$0.07 per trap, and labor from \$0.05 - \$0.07 per trap. This means that every time a trap is lifted and baited, it has cost between \$0.10 - \$0.14 per trap.

Bait Quantity. When water temperatures are lower than 68° F, highest catch and profitability are obtained by using about 1/3 pound of bait. At temperatures above 68° F, catch does increase when more bait is used, but the cost of the bait generally is more than the added revenue. If bait is inexpensive or if much higher catch per trap is experienced late in the season, producers may increase bait quantity per trap. In ponds with low standing crops of crawfish, it is seldom necessary to exceed 1/3 pound of bait per trap.

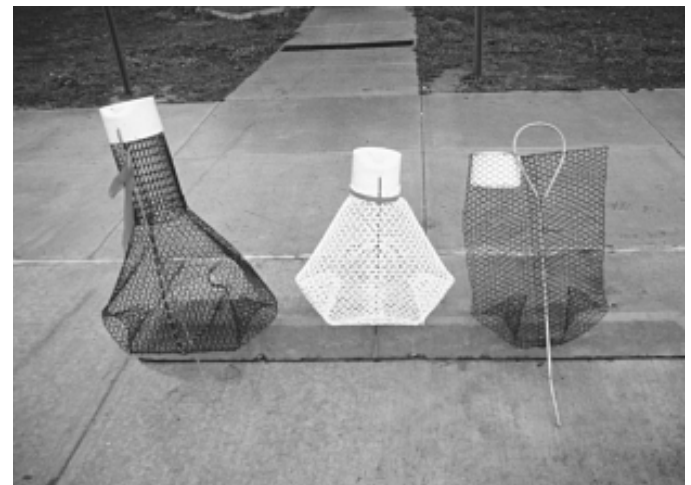
Producers should pay special attention to bait usage patterns. Although a precise amount of bait

cannot be measured for each trap, it can be estimated. For example, a 100-pound box of fish should be sufficient on average to bait 300 traps, or a 50-pound bag of manufactured bait should bait 150 traps. If a significant amount of uneaten bait (residue) remains in traps, particularly in warm weather, then the amount used could be reduced. Likewise, if no bait remains, then the quantity could be increased.

Ideally, bait residue should not be returned to the trap or to the pond. Bait residue will not have the same attractant level as fresh bait, so catch per trap will generally decrease. Bait that is discarded in the pond may still have enough attractants to draw crawfish that would have gone into traps.

Traps

Many different trap designs have been used in the past two decades. The most efficient is the three



Deep water pyramid trap (left), shallow water pyramid trap (center) and stand up trap (right)

funnel pyramid trap made from 3/4 inch PVC-coated wire. It catches 1.5 to three times more crawfish than stand up pillow traps with two entrances. Traps made with PVC or plastic-coated wire catch on average about one-third more crawfish than other types of uncoated traps. The PVC coating also significantly increases the life of the traps. If properly handled, PVC-coated traps can last several years or more. The pyramid traps have

retainer collars that minimize crawfish escape and serve as handles for placing traps. As the name implies, the traps are pyramid shaped and are set upright in the water column.

Trap Density and Spacing

The number of traps set per acre (density) and spacing between traps are important factors to consider before harvesting. Research indicates that 20-25 traps per acre are the optimum number for efficient harvesting in ponds with moderate to high standing crop of harvestable crawfish. To achieve this density, the distance between rows should be about 40 feet and the distance between traps should be about 50 feet. The distance between traps is critical to the efficiency at which traps can be baited and emptied. If the traps are too close together, the harvesting boat must make too many stops to retrieve traps.

Although the same yield can be attained with fewer traps per acre, more bait and labor will be required to harvest the crop. Using more traps per acre than recommended significantly increases bait use and labor and can also reduce the size of crawfish harvested.

Trapping Frequency

Traps are baited and emptied three to six days per week, depending on the catch, price structure for crawfish and market demand. Most baiting regimes are based on a 12-hour or 24-hour trap set. A 12-hour set entails baiting late in the afternoon and emptying (running) the traps the next morning. A 24-hour set entails baiting one day and emptying and rebaiting the trap 24 hours later. There is less escapement of crawfish from the traps on a 12-hour set and more crawfish are caught, but more labor and bait costs are involved.

Plan to empty traps once a day when crawfish size and quantity are good. When size and quantity drop off, reduce the harvest pressure and run traps three to four times a week to allow crawfish more time to grow. Running traps three consecutive days a week can improve harvest efficiency and lower bait and labor cost without significantly reducing

total production. Running traps six or seven days generally results in a significant decrease in catch and crawfish size by the end of the week. If prices, catch and demand are high, however, frequent trapping is justified.

Daily crawfish catch is cyclic and influenced by many factors including water temperature, water quality, weather, forage type and quantity, crawfish growth and recruitment patterns, trap design, baits and harvesting intensity. The major factor influencing catch is density of harvestable crawfish in the pond. Daily catch rates typically range from 1/4 to 3 lbs/trap per day and may average 1 to 1.5 lbs/trap per day in well-managed ponds.

Premium prices offered for late fall to early winter crawfish have caused many farmers to try to manage for an early harvest. Some crawfish ponds will be ready to fish as early as mid-November. At this time catches are usually small (1/4 to 1 lb per trap) and are made up of holdover adults, large juveniles that did not mature in the previous year and the rapidly growing juveniles. There is usually a gap between the catch of holdover crawfish and the juveniles.

Before harvesting early in the season consider:

1. Egg Development (Refer to “Estimating Potential Yield”)
2. Population density (Refer to “Estimating Potential Yield”)
3. Pounds per trap harvested
4. Cost of harvesting
5. Price per pound

Try some of these examples to see if early harvest is economical or if harvest should be delayed until the catch picks up. Consider the number of pounds caught per trap and the price received per trap lift rather than just the price per pound of crawfish caught.



December and January

Average catch = 1/2 lb. per trap.

Price = \$0.80 per lb.

100 acres @ 20 traps per acre

2000 traps X 1/2 lb. per trap = 1000 lbs. X \$0.80/lb
= \$ 800

Cost of harvest \$0.12 cents per trap X 2000 traps
= \$ 240

Return on harvest per day
= \$ 560

March and April

Average catch = 1 1/2 lbs. per trap

Price = \$0.40 cents per lb.

100 acres @ 20 traps per acre

2000 traps X 1 1/2 lbs. per trap= 3000 lbs. X \$0.40/lb
= \$1200

Cost of harvest \$ 0.12 cents per trap X 2000 traps
= \$240

Return on harvest per day
= \$ 960



Providing a Quality Product



Many producers will harvest only two or three days a week rather than every day to compensate for the reduced catch. This should reduce total bait cost, harvest time and harvest labor and allow more time for young crawfish to grow to harvestable size. When the water temperature rises to 60-65 F, crawfish will begin to molt, grow rapidly and become much more active (this generally corresponds to March in south Louisiana). Harvest usually picks up as the water temperature rises.

A volunteer quality assurance program is crucial in providing a positive image of the crawfish industry to the consumer. With a quality assurance program, the consumer has confidence in the product and the crawfish producer has quality as a priority. Providing a quality product starts with proper management of the ponds and includes providing a graded and clean product, handling the product to maximize survival and storage and assuring delivery of fresh, lively crawfish.

Start from the Beginning

The first phase of ensuring quality is in managing the growing conditions of the crawfish. Practice good pond management by providing the necessary food and oxygen that will produce a good quality crawfish. Crawfish harvested from a poorly managed pond are generally stressed and may not survive handling, transporting and storage.

When harvesting, use fresh bait and separate the old bait from the sacked crawfish. Sacked crawfish should be kept off of the bottom of the boat. Oil or gas can kill crawfish and will also give them a strong petroleum flavor.

Grading

Marketing crawfish has changed significantly since commercial crawfish production began. Before 1987, producers had little economic incentive to grow larger crawfish. Consequently, management strategies targeted maximum production and not larger size. The Swedish market demanded a graded product and insisted on large, high quality crawfish. Many consumers, both wholesale and retail, also began requesting a graded product with prefer-

ences for large crawfish. Some form of grading live crawfish will continue to be used regardless of the international market.

Standardization of grading benefits crawfish producers, crawfish buyers, processors and consumers by ensuring consistent size and quality of crawfish wherever purchased. Grading is a positive step toward



A Kerian™ grading device



A water-based grader developed by Sam Rollason, LSU Agricultural Center

marketing quality crawfish. The most commonly used grade categories are in Table 6.

Table 6. Category sizes for Louisiana graded crawfish.

<i>Name</i>	<i>Number/lb</i>	<i>Size</i>
1. Large	15 or less	>32 g
2. Medium	16-20 Count	20-31 g
3. Small	21- More	<20 g

The crawfish industry has developed five distinct grading devices. They include the stationary on-board grader, the shaker grader used on board and on shore, and the tumble grader used on shore. The other two graders are a converted vegetable grader (Kerian™), used primarily by crawfish processors and large volume buying stations, and a water-based grader developed by the LSU Agricultural Center.

Sacking

The quality of the final product sold to the consumer begins with the manner in which the crawfish are first handled by the producer. The common open mesh onion sack is still the preferred method of holding and transporting live crawfish. The sack should be clean and free from dirt and any other contaminants. Sacked crawfish containing debris, dead crawfish and bait reduce the marketability and price.

Because of their aggressive nature, crawfish should be packed tight enough to restrict their movement. Fill sacks completely without overfilling, and secure tightly.



Sacks of crawfish

Keep sacked crawfish cool and moist. They should never be exposed to direct, warm sunlight.

Crawfish harvested early in the season usually have tender, brittle shells and can be crushed easily. Avoid stacking over three sacks high!

Washing

Silt and clay are trapped in the crawfish’s gill chambers when caught. By holding the crawfish in water for a few hours, most of the foreign material is “washed” away. The process renders a cleaner, more attractive product that exhibits a fresher odor and taste when cooked. The process does not clear the digestive system of wastes.

Purging

An estimated 70%-80% of all crawfish produced in Louisiana are consumed locally. Distributors that market the remaining 20%-30% as live and whole-frozen crawfish out of state have developed a small market for a “purged” product. This marketing tactic has reportedly contributed to repeat sales and loyalty to certain distributors.

The purging process is similar in theory to the “depuration” process of the oyster industry. Crawfish are held in purging systems for 24-48 hours, not to reduce harmful organisms as in the oyster industry, but primarily to empty the stomach and intestinal tract of ingested matter. In unpurged crawfish, the intestinal tract is dark and considered unappealing to some. (Local consumers in Louisiana are not overly concerned about the presence of a full intestinal tract.)

Proponents claim purging increases the shelf life of crawfish held in a cooler. The theory is that since the gill area is likely to be freer of mud and debris, taking up oxygen should be easier; and second, by eliminating the gut contents, the potential for stress and disease should be reduced. A recent study showed substantial loss can occur both during and after the purging process when combined with grading. Purging before cold storage usually ensures that crawfish have been handled and subjected to stress for an additional

day (or longer) compared with other crawfish held for the same length of time in cold storage. To decrease mortality during purging, minimize the possibility of shocking the crawfish with abrupt temperature changes, and separate crawfish according to size grade.

Transport and Storage

After harvest is complete, a major task of the producer is to transport a high quality product to the terminal market. High quality means clean crawfish with low mortality. To ensure that crawfish are delivered to the terminal market properly, remember these recommendations:

1. Transport crawfish to on-the-farm coolers or to the terminal market as soon after harvest as possible.
2. Always make sure the vehicle used for transporting is clean and free from petroleum products, pesticides or any contamination.
3. Do not expose sacked crawfish to excessive wind and bright sunlight. Always cover the catch with wet burlap or tarp when transporting.
4. Take extreme care when unloading at the terminal market.
5. Storage

a. Temperature: It's recommended that crawfish be stored in a cooler between 38-41 F. The quality of the product will deteriorate if it is kept too cold for too long.

b. Humidity: High humidity will minimize drying of crawfish gills and extend shelf life of the stored product.

c. Time: Mortality increases as storage time and handling increase. Crawfish mortality in a cooler usually doubled (from 10%) after purging or when storage was increased from four to six days. Poor quality crawfish will last only a few hours regardless of what conditions they are stored in.





Draining Ponds

No specific date is considered the perfect time to drain a crawfish pond. There are a number of factors to consider before draining. The existing crawfish population should be evaluated before making a final decision to drain. In a normal situation, draining and/or releasing the water could begin when at least 20% of the female crawfish show signs of egg development. Ponds should be drained over a 10- to 14- day period for older, established ponds. There are a couple of things to remember when draining:

1. Make sure 20% of the females are in the tan or brown egg stage or burrowing is beginning.
2. Drain off the water slowly 1 to 1 1/2 inches per day except where crawfish are stunted.

Draining a crawfish pond early (March) to plant a rice crop often forces immature crawfish to burrow into the levees. This could delay next year's harvest. Waiting until later (May-June) to drain a pond will allow a higher percentage of crawfish to reach maturity and ensure that a larger number of crawfish will burrow.

If the decision has been made to quit harvesting, and immature, young crawfish make up a large part of the pond population, a different draining procedure should be used. In this situation, drop the water level quickly to 8 - 10 inches, then hold until the water temperature increases. Dropping the water and allowing the water temperature to rise will induce the crawfish to mature quickly and begin burrowing activity.

Summer Care of Crawfish

There are a few things you can do to help crawfish that have already burrowed make it through the summer. In ponds that are rice/crawfish double cropped, do not use chemicals indiscriminately. Nearly all insecticides are toxic to crawfish (see section on Pesticide Toxicity), so follow label directions carefully! If an insect problem arises in a rice field stocked with crawfish, a producer must first consider which is the primary crop — rice or crawfish. If it is rice, management goals should be to maximize the rice yield. If

crawfish are burrowed at this time they should be out of harm's way.

In summer, minor levee work around a crawfish pond can be performed. Ten to 12 inches of loose soil can be added to the top of the burrows without causing serious crawfish mortalities, but the less soil added, the better. When levee work is necessary, if at all possible use soil from outside of the pond. The less disturbance done to the interior portion of the levee where crawfish burrow, the better the crawfish survival rate. Preparing a seed bed in a crawfish pond to plant a forage can be done with little or no effect on crawfish that have already burrowed.

Land leveling or major levee repair will increase crawfish mortality. Severe compacting of soil by heavy equipment may not allow crawfish to escape from burrows and will result in death. In these cases it is recommended that 10 - 15 pounds of mature broodstock crawfish be added to the pond after leveling or major repair. Do this when the newly planted rice has reached 10 - 12 inches. Follow the normal stocking procedures.

When rice is drill seeded for crawfish, don't hold a deep, permanent flood on the rice. A deep, permanent flood late in the summer may cause crawfish, both holdovers and newly hatched, to emerge from their burrows. The adults will be able to re-burrow, but the young will generally not survive. A flush of water on the field for only 12-24 hours will irrigate the rice, yet avoid large numbers of crawfish emergence.

Rice farmers who are raising crawfish probably know that rice/crawfish rotation is not a perfect fit. Minimizing the detrimental effects on one crop and maximizing yields on the other may be difficult. In most cases, common sense and proper water and soil management will benefit both crops. If a producer is in doubt about the consequences of a management procedure, it's better to ask for advice rather than lose a potential money-making crop.

Additional Sources of Information



These publications can be obtained from your parish office of the Louisiana Cooperative Extension Service. Out-of-state requests should be directed to: Publications Office, Louisiana Cooperative Extension Service, P.O. Box 25100, Baton Rouge, LA 70894-5100.

Forage:

Rice Varieties and Management Tips, Pub. 2270

Rice Diseases, Pub. 2241

Rice Insect Identification Guide, Pub. 2307

Fertilization of Louisiana Rice, Pub. 2418

Economics:

Projected Costs and Returns and Whole Farm Analysis for Major Agricultural Enterprises, Louisiana, 1996. January 1996. A.E.A. Information Series Nos. 135-142. LSU Agricultural Center.

Louisiana Fisherman's and Trapper's Record Book, Pub. 1983

Louisiana Farm Record Book, Pub. 1291

Louisiana Farm Inventory Record, Pub. 1849

Aquaculture:

Louisiana Crawfish, Pub. 2626

Small-scale Marketing of Aquaculture Products, Pub. 2399

Toxicity of Selected Agricultural Pesticides to Common Aquatic Organisms in Louisiana, Pesticide Education Information Series, Pub. 2416-I

Acute Toxicity of Agricultural Chemicals to Commercially Important Aquatic Organisms, Pub. 2343

Handbook for Common Calculations in Finfish Aquaculture, Pub. 8903

Avian Predators: Frightening Techniques for Reducing Bird Damage at Aquaculture Facilities, Pub. 2466

Avian Predators on Southern Aquaculture, Pub. 2465

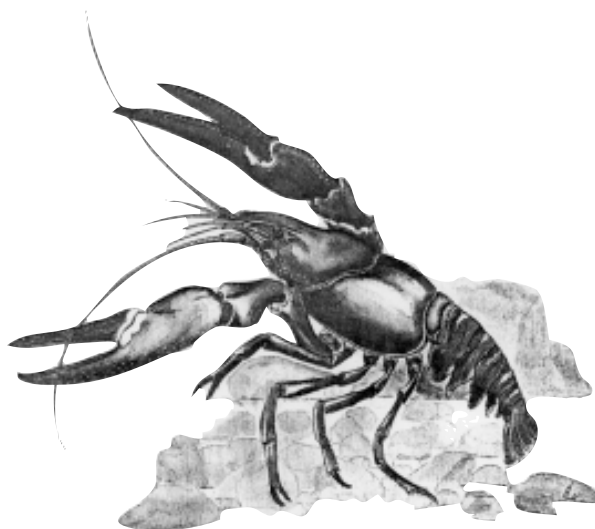
Aquatic Weed Management Herbicides, Pub. 2398

Aquatic Weed Management Control Methods, Pub. 2410

This publication can be obtained by contacting : Publications Clerk, Louisiana Sea Grant Program, LSU, Baton Rouge, LA 70803.

Red Swamp Crawfish: Biology and Exploitation. Third Edition. J.V. Huner and J.E. Barr. Louisiana Sea Grant Program.





Acknowledgment

This publication was partially funded by the Louisiana Crawfish Promotion and Research Board.

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Pub. 2637

(500)

7/99 Rev.

Issued in furtherance of Cooperative Extension work, Acts of Congress of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. The Louisiana Cooperative Extension Service provides equal opportunities in programs and employment.