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Revision

Crawfish Production

Production Systems and Forages

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Crawfish, especially the red swamp crawfish (*Procambarus clarkii*) and the white river crawfish (*Procambarus zonangulus*), are suitable for culture because they are hardy and adaptable. Crawfish production can be integrated with agricultural crop rotations, and the crawfish life cycle can be easily manipulated to fit a variety of cultural situations. Crawfish aquaculture relies on control of pond hydrology to simulate optimal wet and dry conditions occurring in natural riverine and wetland habitats. Crawfish grow and mature during the wet or flooded cycle and survive the dry periods by digging burrows. 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.

Crawfish production systems

Crawfish ponds can be single-crop and rotational. Single-crop ponds are in the same location every year with a continuous management scheme. Rotational ponds are those in which crawfish are rotated with other crops. Rotational production also can mean rotating the physical location of the field in which crawfish are grown.

Single-crop ponds

Single-crop ponds are constructed and managed solely for the purpose of culturing crawfish. Crawfish can be harvested in single-crop ponds 1 to 2 months longer than in some rotational systems because there is no overlap with planting, draining, and harvesting schedules of other crops. The three principal types of ponds are cultivated forage ponds, naturally vegetated ponds, and wooded ponds. The following crawfish culture cycle is applicable to each of the three types:

April - May: Stock 50 to 60 pounds of adult crawfish per acre (new ponds only).

May - June: Drain pond over a 2- to 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.

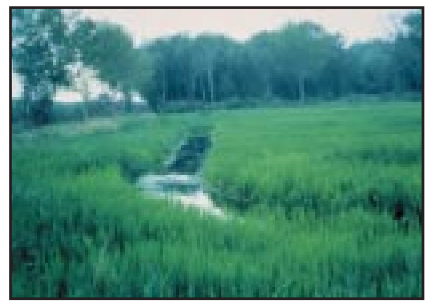

Figure 1. Cultivated forage crawfish pond.

Cultivated Forage Pond. These are permanent ponds where a cultivated forage crop is established annually (Fig. 1). Ponds are usually tillable to facilitate planting and management of rice or other agronomic crops. Ponds are often designed with baffle levees and recirculation systems to improve production. Because they are intensively managed, cultivated forage ponds generally have the highest yields (pounds of crawfish) per acre.

Naturally Vegetated Ponds. These are marsh impoundments and agricultural lands managed to encourage the growth of naturally occurring vegetation. Marsh ponds are typically constructed in wetland areas with large amounts of organic matter in the soil, which may lower water quality and decrease crawfish production. Although these ponds may be managed exclusively for crawfish,

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they are generally not recommended for commercial crawfish production because yields are inconsistent.

Agricultural lands unsuited for growing grain crops because of poor drainage or soils are sometimes used for naturally vegetated crawfish ponds. It can be difficult to establish an adequate forage base with the proper balance of aquatic and terrestrial plant species. Water management also can be a problem. However, these kinds of ponds can sometimes be effective low-input production systems.

Wooded Ponds. These ponds are built on heavy clay soils in forested (cypress-tupelo swamps) areas near drainage canals. Water temperatures tend to be lower because of shading. Wooded ponds have poor stands of vegetative forage; leaf litter provides the bulk of forage. However, rapid leaf fall can cause water quality to deteriorate because oxygen may become depleted as leaves decay. Trees hinder water movement and obstruct access by harvesting boats, so they are sometimes removed. More intense water management is needed to maintain good water quality in wooded impoundments.

Wooded ponds usually produce fewer pounds of crawfish per acre than other production systems, but large crawfish may be produced at a profit. After several years of alternate flooding and drying, wooded ponds lose many hardwood trees. A natural vegetation base of terrestrial grasses and aquatic plants subsequently develops, which improves crawfish habitat. There are some positive aspects of wooded ponds, including the potential for waterfowl hunting, the low initial start-up costs, and the ability to selectivly remove unwanted vegetation.

Rotational ponds

The most common rotational pond systems are rice-crawfish-rice, rice-crawfish-soybeans, and rice-crawfish-fallow. In the rice-crawfish-rice crop rotation, both rice and crawfish crops are harvested annually. This is commonly referred to as double cropping. In the rice-crawfish-soybeans rotation, farmers produce three different crops in 2 years. In the rice-crawfish-fallow rotation, farmers leave the field fallow between rotations to control weeds and prevent crawfish overpopulation. In this system, crawfish are produced in different physical locations from year to year.

Well managed crawfish rotation systems use farm resources efficiently, diversify production, and add income for many farm families. However, maximum production from each crop usually is not achievable. Some management compromise is necessary from one or all crops.

Rice-Crawfish-Rice. Rice fields are the most readily adaptable areas for crawfish culture. The rice farmer can use 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 re-grow. This ratoon crop is the forage base for crawfish production. Maximum crawfish production is sometimes compromised because rice culture takes precedence over crawfish production. For example, rice production often requires the use of pesticides and different water management than is optimal for crawfish. These ponds are usually drained in early spring (March 1 to April 1) so that rice can be replanted. This shortens the crawfish harvest season 1 to 2 months and reduces potential crawfish yield. A typical time-table is as follows:

March - April: Plant rice.

June: At permanent flood (rice 8 to 10 inches high), stock 40 to 50 pounds of adult crawfish per acre.

August: Drain field and harvest rice.

October: Re-flood rice field.

December - April: Harvest crawfish.

March - April: Drain pond and replant rice (restocking of crawfish may or may not be necessary).

Rice-Crawfish-Soybeans. This rotation allows for the production of three different crops in 2 years while offering the advantage of better weed and disease control than rice-crawfish-rice rotation. It also has the advantage of a longer crawfish harvest season. Pesticide use may limit crawfish production in this rotation. A typical time-table is as follows:

March - April: Plant rice.

June: Stock 40 to 50 pounds of adult crawfish per acre at permanent flood.

August: Drain field and harvest rice.

October: Re-flood rice field.

December - May: Harvest crawfish.

Late May - June: Drain pond and plant soybeans.

October - November: Harvest soybeans.

November - March: Re-flood pond and harvest crawfish (or leave field fallow).

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 to break the natural cycle of weeds and crop diseases. Fallowing also prevents crawfish overpopulation. This system allows for optimum production of both crops, but requires more land and reduces potential income. A typical time-table is as follows:

March - April: Plant rice.

June: Stock 40 to 50 pounds of adult crawfish per acre at permanent flood.

August: Drain pond and harvest rice.

October: Re-flood rice field.

December - June/July: Harvest crawfish.

July: Drain pond.

August - March: Fallow.

March - April: Plant rice.

Forages

In a natural ecosystem, crawfish eat a variety of plants and animals. Crawfish prefer aquatic invertebrates but will feed on detritus and growing vegetation. Detritus, or decomposing organic material, is the base of the complex, self-sustaining food system required in crawfish culture (Fig. 2).

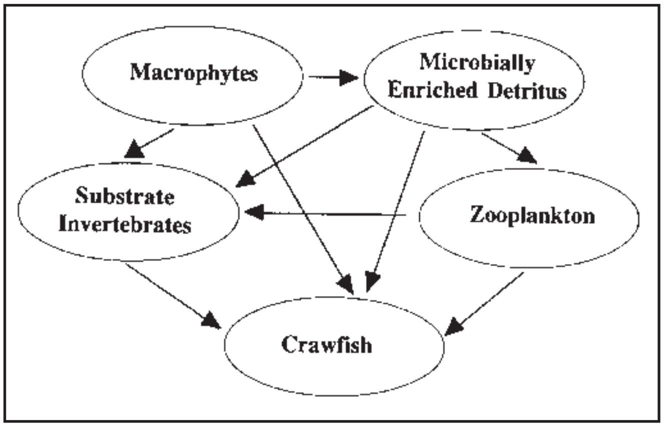

Figure 2. Food-web of crawfish.

As organic matter decomposes, it becomes "coated" with bacteria, other microorganisms, and small invertebrates that increase its nutritional quality. Larger aquatic fauna such as insects, worms, clams, snails and zooplankton feed on the enriched decomposing vegetation. It is these animals that make up the major part of the crawfish diet. Crawfish eat very little living plant material, but rely on the small invertebrates that live on or near plant stems. Some plant seeds may also be important food resources.

Crawfish production can use planted and cultivated forage crops or voluntary natural vegetation. The forage must provide detritus to the underwater food-web consistently throughout the growing season. Many aquatic plants, such as alligatorweed (*Alternathera philoxeroides*), perform this task poorly but can provide substrate and cover for other organisms that are food for crawfish. Cultivated crops are more consistent from year to year and usually provide for a more consistent supply to the underwater food-web.

Cultivated forages

Cultivated forages provide a controlled, consistent supply of detritus that results in good crawfish yields. Planting an agronomic crop 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. Research has shown that potential crawfish yield can be increased 2- to 3-fold with good stands of cultivated forage as compared to using natural vegetation only.

Rice (*Oryza sativa*) is the preferred forage for crawfish. Rice is less detrimental to water quality than terrestrial plants. It can be planted for grain production, with the post-harvest residue and regrowth serving as crawfish forage, or it can be planted solely as a crawfish forage with no intent to produce grain.

When selecting a rice variety for crawfish production consider the culture system (rotational or single cropping), forage biomass production, lodging characteristics, disease resistance, adaptability to local environmental conditions, and rice ratoon potential. Check with your county Extension agent for a list of recommended rice varieties to use solely as planted forages.

Rice for Grain and Forage. Proper variety selection and cultivation practices will ensure optimum grain yield, but several other considerations are important when crawfish production is to follow. Timing of the grain harvest is determined by the time of planting, the variety, and the weather; it will also affect subsequent forage production. For best results, the ratoon crop should reach maximum forage production after the harvest but should not reach full maturity. Ratoon crops that do reach full maturity wither (senesce) and often become prematurely depleted, causing forage shortages.

Huge amounts of loose plant stalks and leaves remain in the field after grain harvest. This residue should be reduced before the field is re-flooded or it will cause water quality to deteriorate. A straw chopper on the rice combine will chop up the excess straw into smaller pieces that decompose more rapidly during the weeks before re-flooding. Or, the harvest residue can be bailed or burned.

Dead plant material can not be effectively stockpiled in a pond. The only way to increase long-term supply is to encourage regrowth of rice stubble after the grain has been harvested. A light application of nitrogen (20 to 40 pounds of nitrogen per acre) can be applied shortly after harvest. The field should then be flushed if adequate moisture is not available. 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. The variety chosen should produce high vegetative biomass, be resistant to lodging and disease, senesce slowly, and persist throughout the crawfish production season. Forage rice should be planted early enough to allow maximum vegetative growth without reaching full maturity. Flooding immature rice results in better water quality because there is less decomposing organic matter at the time of fall flooding. Rice that does not reach full maturity persists longer under flooded conditions and is more likely to generate additional growth in the spring.

The potential and requirements for rice production to be adequate for crawfish culture vary from area to area. Follow the recommended practices for your region. In general, rice is either drilled or broadcast planted in well-tilled seedbeds at rates ranging from 90 to 120 pounds per acre. Although rice requires considerable water for growth, commercial rice producers maintain a shallow flood mainly for weed control and better fertilizer management. This is not necessary when growing rice for crawfish forage; in fact, standing water on the seed or seedling, if it is too hot, can result in poor stands. Rice may be irrigated during dry periods. Fertilizer usually is required for good rice growth and development; soil should be tested first to determine its fertility. A common application rate is 60 to 80 pounds per acre of nitrogen (N) and 30 pounds per acre of both phosphorus (P) and potassium (K). Herbicides are not necessary. Some weed invasion is not harmful (and may even be desirable) in crawfish crops. Consult knowledgeable professionals for assistance.

Sorghum-sudangrass. Good rice stands may be difficult to achieve in some geographical regions and under some environmental conditions, especially during late summer in the southern U.S. Other forage crops, such as sorghum-sudangrass hybrid (*Sorghum bicolor*), may be a good alternative for crawfish forage (Fig. 3).

Figure 3. Sorghum-sudangrass as forage in crawfish pond.

Sorghum-sudangrass seed is available from most farm suppliers and seed dealers. It grows rapidly, produces larger quantities of vegetative matter than rice, is drought resistant, and may be more reliable than rice for late summer stand establishment. Sorghum-sudangrass tends to persist longer than rice in flooded crawfish ponds, which makes more forage available during the latter part of the crawfish growing season.

Sorghum-sudangrass should be used only in ponds where a forage is planted in late summer. Target planting dates should be early August through early September in the deep South.

If planted too early, sorghum-sudangrass is likely to mature before flood-up, which can be detrimental to water quality when plants lodge or large numbers of leaves sluff off into the water. However, planting should not be postponed too long because cooler weather and the shorter days of early fall may inhibit plant establishment and growth. Advanced stands of sorghum-sudangrass should be cut to a 1- to 2-inch stubble in early to mid-August and baled.

Sorghum-sudangrass seed can be drilled or broadcast onto moist soil. Drilling is preferred and is less risky. Seeding rates should be 20 to 25 pounds per acre for drilling and 25 to 30 pounds per acre for broadcasting. Optimum germination temperature is 70 to 85 degrees F. Seeds need adequate soil moisture to germinate, but the seedlings are fairly drought tolerant once they are established. Sorghum hybrids are sensitive to very low soil pH but seem to tolerate a pH as low as 5.5 without problems. Fertilizers can significantly increase growth and the vegetative biomass of sorghum-sudangrass. Follow the Cooperative Extension Service fertilizer and culture recommendations for sorghum-sudangrass in your area.

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.

Pesticide toxicity

Be careful using pesticides in or near crawfish ponds; crawfish are very sensitive to most chemicals and carelessness can quickly eliminate production. Read the label of any chemical or compound before using it.

Natural vegetation

Natural voluntary vegetation is usually the least expensive to establish and can sometimes be satisfactory as a forage crop; however, it is often unreliable and insufficient for maximum crawfish production. 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 (*Alternathera philoxeroides*) and smartweed (*Polygonium* spp.) are superior to terrestrial grasses because they continue to live when flooded. During much of the season little material is cast from these plants to form detritus. However, during the winter the emergent parts of the plants die and form large amounts of detritus, usually at a time when low water temperatures reduce feeding by aquatic organisms.

The three major disadvantages of using natural vegetation are: (1) stand density varies with location and 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 subsequent years. Despite these obstacles, ponds with an appropriate mixture of aquatic, semi-aquatic and terrestrial vegetation do occasionally produce good crawfish crops.

Forage production is one of the most important components of crawfish production. This publiction has outlined the basics of forage based production systems for crawfish in the Southeast. For more information on crawfish production contact the Extension Fisheries/Aquaculture Specialist in your state.

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