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Crawfish Production

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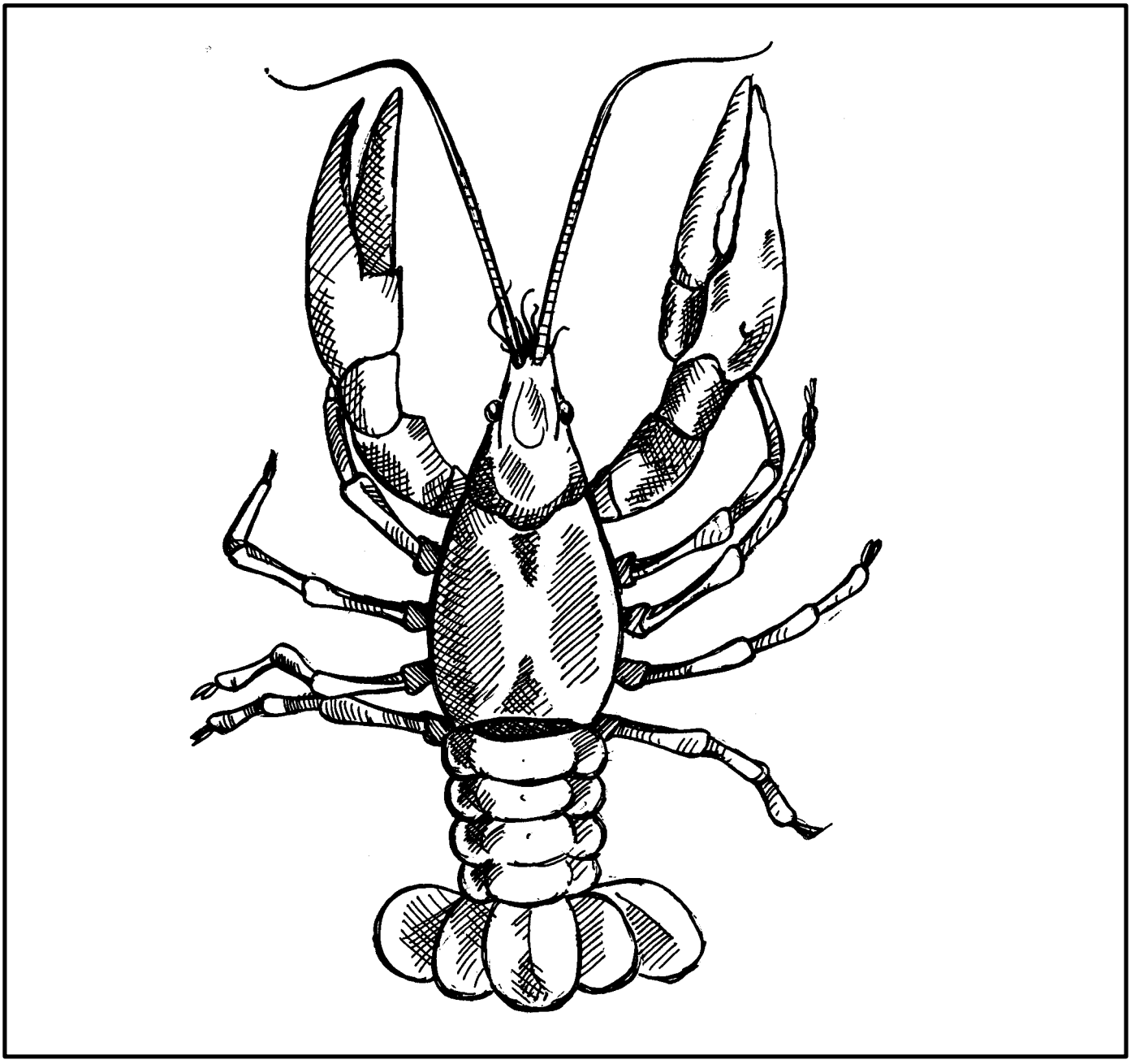

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Crawfish Production

Crawfish are known by many names - from crayfish to stonecrab. Their culture dates back to the late 1700s when they were reared as gourmet items. They are native in freshwater of all continents except Africa and have been introduced there. Crawfish vary in size at maturity from the dwarf crawfish, less than 1 inch in length, to a Tasmanian species which reaches weights of over 8 pounds. Colors vary from a light cream color through yellow, blue, red and green to black.

In the early 1930s, Percy Viosca published recommendations for raising crawfish in ponds in Louisiana. Since that time, interest in culturing crawfish has increased steadily and over 131,000 acres of ponds were reported in the United States in 1990. Total harvest figures are difficult to obtain, but it is estimated that in the United States harvest exceeds 100 million pounds per year.

Most of the crawfish consumed in the United States is from Louisiana, although other states have begun to culture crawfish in the past 10 years. From Maryland to Texas to Oregon, crawfish are considered a delicacy and the demand for "Cajun" dishes featuring crawfish is growing steadily. The market for crawfish in Europe has become accustomed to crawfish grown in the United States and exports are increasing steadily. Crawfish production for food will probably double within the next 10 years.

The crawfish industry is becoming more specialized. Traditionally, most crawfish were cooked and eaten near production locations. Recently, more and more crawfish have been processed, the tail meat frozen and shipped to other locations. This trend is expected to continue. In addition, products such as microwave-ready dishes, precooked and specialty dishes are being developed. These will mean more crawfish available to more people and an expanding market.

Over 90 percent of crawfish cultured in the United States are either red swamp crawfish (Procambarus clarkii) or white river crawfish (Procambarus acutus). Actually, these common names are misleading because the white river crawfish does not require running water nor does the red swamp crawfish require a swamp. As adults, both generally exceed 3 inches in length. They are reddish in color with the intensity of the color depending on the length of time since their last molt. The red swamp crawfish tolerates warmer temperatures and poorer water quality than the white river crawfish. Figure 1 shows the major differences between the species. In addition, the red swamp crawfish generally has a blue vein on the underside of the tail which is not visible in the white river crawfish.

Another crawfish which is used for food is the signal crawfish (Pacifastacus leniusculus) from the western United States. This is a rather large, non-burrowing crawfish which is found in streams among large rocks or similar cover. Because it is the largest crawfish native to the United States, it is caught for those markets which require an animal weighing from 2 to 4 ounces or more.

Three other species are regularly produced for either food or fish bait. These are the paper shell crawfish (Orconectes immunis), the green pond crawfish (Orconectes nais) and the northern crawfish (Orconectes virilis). All three can be found in ponds and lakes. The paper shell crawfish is better adapted for culture where shortages of water may cause ponds to dry up. All six species of crawfish are captured from streams, lakes and ponds as a "wild" crop.

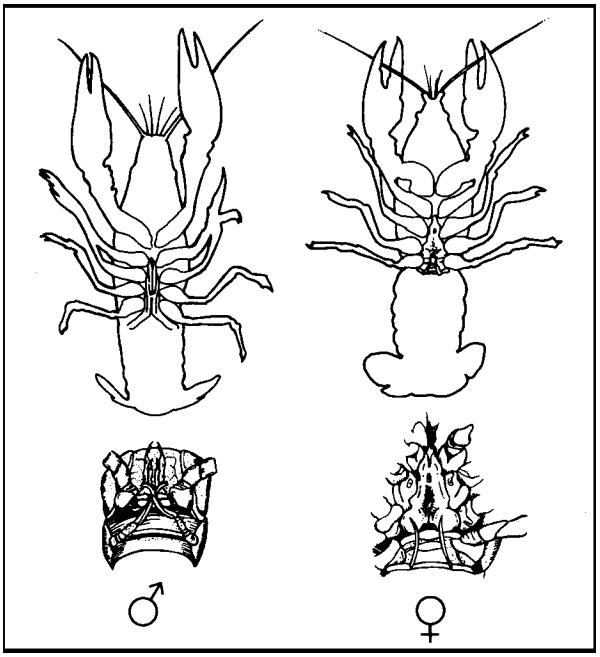

Figure 1. Underside of male and female crawfish showing copulatory stylets in the male and seminal receptacle of the female.

LIFE HISTORY

The crawfish is a shellfish or crustacean, meaning that it has a hard shell composed of chitin. This shell is the skeleton of the crawfish and protects the soft organs. For the animal to grow, it is necessary that it periodically molt or shed its shell and grow a new one. Molting usually occurs in a burrow or some other cover required for protection during this period of vulnerability. Crawfish are cannibals and consume other crawfish that are molting. This is especially true for the very aggressive red swamp crawfish and white river crawfish. Crawfish molt at least 11 times before they are mature and many are lost to predation.

Growth or lengthening during each molt depends on the habitat. In small ponds or aquaria, the normal growth increment may be ¼ inch or less, while in well-managed culture ponds it may exceed ½ inch. The time from hatching to maturity depends on food availability, presence of water, temperature and oxygen content of the water. Optimum temperature for growth is 75°F - 85°F. Growth is slower at either higher or lower temperatures. Food must contain adequate amounts of calcium carbonate (limestone) for shell development. The amount of oxygen in the water affects growth because at low oxygen concentrations crawfish do not feed. Under ideal conditions, red swamp crawfish may molt every five days. Some crawfish reach maturity within two months after hatching while others may require six months or more.

The peak of the breeding season usually occurs in May and June but may occur at other times of the year depending on temperature and other water conditions. The sperm is viable for at least 8 months. As the eggs are laid they pass over the cavity where the sperm was deposited and fertilization occurs. The female then secretes a sticky substance called glair which covers the eggs and causes them to stick to the swimmerettes under her tail.

Red swamp crawfish eggs hatch in 14 to 21 days depending on temperature, while white river crawfish usually require about six additional days. Flipping of the tail is the primary way crawfish move quickly. Holding the eggs under the tail makes the female easier prey for predators. Therefore, just prior to egg laying the female either digs a burrow or finds a hole or other cover. The burrows of each species of crawfish are distinctive. Red swamp crawfish burrows are 1 ½ to 3 inches in diameter and are usually dug straight down. White river crawfish burrows are generally dug into sloping banks and are horizontal for 12 to 16 inches before going more or less straight down.

The length of time the female remains in the burrow or other hiding places depends on water conditions. If ponds are drained or dry up during the summer, females will burrow in June or July and remain there until it rains in the fall or water is pumped back into the ponds. The small crawfish usually are carried under the tail of the female for 5 to 10 days after hatching. Under optimum conditions in the southern United States, the peak of hatching is in September and October. If plenty of good quality water is present, the young crawfish will begin to feed and grow. If no water is available, some of the young will be released in the burrow and very little growth will occur.

Crawfish eat almost any plant material but seem to prefer fresh tender vegetation. Decaying plants are also consumed readily, but plants with coarse textures are not consumed. Crawfish are particularly attracted to fresh meat and fish. They tend to avoid decaying animal matter. In the wild, about 20 percent of their diet consists of worms, insect larvae and other invertebrates found on plants or the pond bottom. Much of this food is microscopic in size and found on or in decaying vegetation. Most crawfish culturists believe that green vegetation which contains carotene is necessary to produce the bright yellow "fat" or hepatapancreas which is desired for "Cajun" dishes.

The habitats of crawfish vary, but they prefer areas with some cover such as rocks in streams or dense vegetation in lakes and ponds. Crawfish generally feed on the bottom and will not feed on the surface or on land except at night, when they are relatively safe from predators.

SITE SELECTION AND DEVELOPMENT

Site selection is the most important consideration in establishing a viable crawfish production system. Because crawfish production is concentrated in the southern United States, this discussion will use criteria developed there. Prospective producers in other areas should look for similar locations unless cool water, non-burrowing species are to be grown. The land area selected must be fairly flat. Heavy, black, clay soils with more than 500 ppm of calcium are preferred.

The source of water is the next consideration. Sufficient water should be available to fill the ponds to a depth of 18 inches within 72 hours. This means a water flow in excess of 100 gallons per minute per

acre must be available. Good quality water is required for maximum production. Waters with a hardness of over 100 ppm are preferred. Well water has the advantage of not containing fishes (crawfish predators) but may be too soft and lack sufficient dissolved oxygen.

Finally, the site should be near a good road network to facilitate marketing and management. Because land prices vary widely, there are no cost guidelines.

Pond Construction

Pond construction costs depend on the site chosen. General guidelines follow.

Ponds should not exceed 20 acres in size and must retain at least 16 inches of water. Outside levees should be 36 inches high after settling. Levees should be wide enough to permit vehicular traffic on at least two sides to facilitate harvesting and water management. The pond should be completely open with no trees, brush or brush piles. Provisions should be made to drain the pond annually. Drain pipes should be large enough to drain at least 3 inches from the pond in 48 hours. Drain pipes should have screens ½ inch or smaller mesh to discourage crawfish leaving the pond. Construction costs may vary from $200 to $500 per site per acre depending on soils, topography, etc. (See Figure 2).

Figure 2. Production Pond

Water Delivery and Distribution Systems

Water delivery and distribution systems are major factors in determining the success of a crawfish production system. Pumps or circulators vary in cost but normally should not exceed $500 per acre.

Double Cropping

Double cropping with rice, soybeans, grain sorghum or duck hunting are all practiced in some areas of the South. This may reduce the cost of developing a crawfish production operation if such facilities are already in place. They will also provide greater flexibility in operation. It is apparent that any double-cropping system will necessitate the elimination of some practices which maximize production of a single crop. Draining the ponds to plant rice normally occurs when crawfish harvest is at its peak. Harvesting of beans is usually not early enough to allow for reflooding of the pond for a good fall crop of crawfish. Waterfowl hunting will interfere with crawfish harvesting and both geese and ducks will consume some of the forage usually available for crawfish.

State and Federal Permitting Requirements and Regulations

State and federal permitting requirements and regulations have a definite effect on development costs. Many areas which are appropriate for crawfish production are classified as wetlands and may not be altered without a government permit. Many states have regulations limiting the amount and quality of water that can be used for any type of agriculture. This may preclude establishing a crawfish farm or may require additional expense.

PRODUCTION METHODS

Many species are native to most parts of the United States. In the South the preferred species are the red swamp and the white river crawfish. In the Midwest the red swamp, paper shell, green pond and the northern crawfish are available. Selecting the proper species depends on whether production is for fish bait or human food. Many states have regulations prohibiting the introduction of certain species. Check before stocking any crawfish from another area.

Selection of Broodstock

Selection of broodstock is relatively easy if the crawfish are stocked during the peak of the harvest season. At this time, the sex ratios are usually about equal. For burrowing species, care must be taken in the collection of broodstock. After the peak of the harvest season, females begin to burrow earlier than males. Crawfish caught from a pond during this period may be mostly males. If possible, secure crawfish from production ponds near the new ponds. This will ensure they are adapted to local climatic conditions.

Stocking

If crawfish of the desired species are present in the area, 40 to 60 pounds are stocked per surface acre of water. If the desired species are not present, then stock 100 pounds per acre. The preferred stocking time will vary from early May in the South until late June in the upper Midwest. Normally, the shorter the time between trapping and stocking, the better the survival. Some vegetation in the pond will reduce predation.

Feeding

Planted crops such as rice or native aquatic plants provide food for crawfish. Crawfish feed on these plants, insects and other animals living in the pond. Very little research has been done on commercial rations for crawfish production, but several feeds have come onto the market since 1986 and are available in many areas. These feeds may not have all required nutrients for intensive production. In these cases, forage crops must be provided to supplement the diet. If the crawfish are to be produced in a confined area, complete feeds are required. Nutritional requirements of crawfish are not well defined. It is difficult to formulate a complete crawfish ration.

Water Management

Water management is the most important aspect of crawfish production. Very little can be done about water temperature except to plant cover crops to help shade the water during the summer. Dissolved oxygen in the water can be controlled by careful management. The dissolved oxygen content of the water should remain above 3 ppm at all times. Relift pumps with sufficient capacity to pump the entire volume of water in the pond twice weekly are needed. Water flow should be channeled to avoid uncirculated areas. Recently, paddle-wheel circulators and other water movement devices have been used to recirculate water in crawfish production ponds. They are usually more energy efficient. (See Figure 3).

Other considerations affecting water quality include the feeds or forages used. If rice is planted for feed and the pond is flooded while the rice is actively growing, the rice will continue to live. This will have only minor effects on the water quality. If plants which normally grow on dry land are planted in the pond, water quality deteriorates as the plants die and decay. Large quantities of decaying vegetation may cause oxygen depletions. This may cause many crawfish to die, particularly the younger ones.

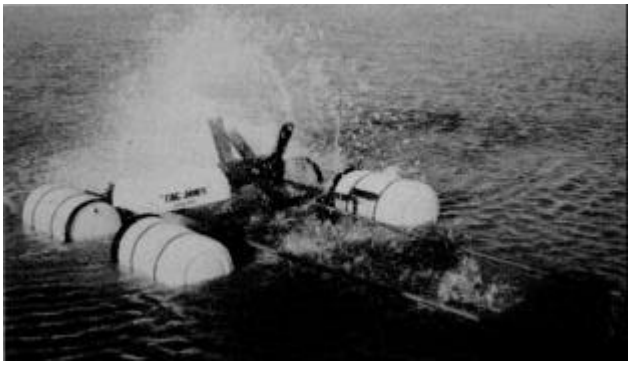

Figure 3. Paddle Wheel

Water quality problems continue to be a major constraint to crawfish production. This is compounded where water supplies are marginal. If dissolved oxygen levels are inadequate, crawfish production is reduced. If waters are too soft, production requires treating the water to increase calcium content. Pollution from agricultural, municipal or industrial sources may decrease crawfish yields.

Harvesting

Crawfish harvesting is usually done with baited traps. There are several types of traps. Traditional pillow traps are fished in water depths up to 6 feet. For the normal shallow ponds, some type of stand-up trap is used. These traps are constructed of wire or plastic with 3/4-inch mesh. They normally have entrance funnels on at least three sides and some method to keep the crawfish from leaving the normally open tops. (See Figure 4).

Once each day the harvester comes to each trap and dumps the crawfish into a tub or other holding container. As these are filled, they are taken directly to the holding facility where they are either placed into purge tanks or sacked for delivery to a processor. Some use a sacking table in their boat to save time and labor. Because of the mesh size of the traps, nearly all of the crawfish caught in traps are of salable size.

Traditional bait for traps has been some type of oily fish such as gizzard shad or carp. Fish are cut into about 4- to 6-ounce pieces and dropped into the trap. New bait is added daily. Beef melt and chicken parts are also used. Baits manufactured from grains supplemented with fish oils or other scents have recently become available. These baits are easily stored and may last longer in the traps.

Time of harvesting varies with the location of the production facility. In the South, harvesting is market driven. This means that many growers begin harvesting

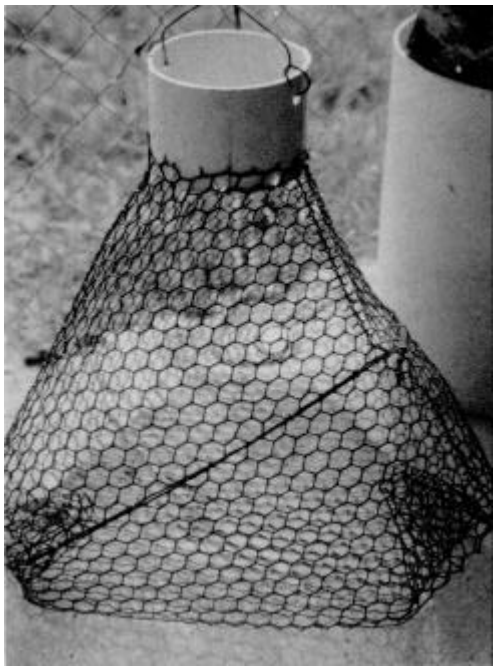

Figure 4. Crawfish Trap

in the late fall, October or November and continue harvesting daily until June of the following year. If markets are available through the year, harvesting may continue through the summer. In the Midwest, harvesting normally does not occur during December through March as the ponds either ice over or cold water temperatures restrict crawfish movement.

Harvesting equipment is a matter of individual choice. Many growers use shallow draft boats with weedless outboard motors. Others use some form of drive wheel to push their boats through the water. High-wheeled, engine-driven, tractor-like vehicles are also used in some areas. For small ponds many growers prefer to walk and pull a boat behind them. Tubs are placed in the boat along with a bait container.

PROBLEMS OR CONSTRAINTS

Parasites and Disease

There are relatively few crawfish parasites and diseases in the United States. On occasion, fungus infections occur on eggs, but the incidence is low and usually not considered serious. Small, leech-like worms are occasionally seen on crawfish. These are not parasites and do not affect the crawfish. Crawfish commonly have many very small insect eggs on the shell. They are usually around the head and back and are not a hindrance to the crawfish.

Vegetation

Crawfish production requires vegetation management expertise. Appropriate vegetation must be available at the proper time in the production cycle. The use of formulated feeds may eliminate some of these problems.

Predator Control

Predator control is a constant problem for most producers. Most fishes, as well as many other animals, eat crawfish. Raccoons and mink are usually controlled by trapping. Other animals are less of a problem but may be a nuisance. Many species of birds feed on crawfish. Most of the wading birds are protected by state and/or federal laws. Scare devices have been partially successful. Screening or other visual devices are expensive. Poachers are a problem in certain areas. Most state laws are inadequate to protect crawfish producers from poachers.

Legal Considerations

Crawfish production may require licenses. Wateruse permits must be secured in most states, particularly if water is in short supply. Discharge permits are required in many states. Some states prohibit the introduction of new species. Prospective producers should check with local, state and federal regulatory agencies prior to establishing a crawfish operation.

MARKETING

There are two primary sales outlets for cultured crawfish - the bait market and the food market. Crawfish are a preferred bait by many fishermen as they are readily taken by bass, most sunfish and catfish. Small crawfish (less than ¼ ounce) are the preferred size for sunfish and bass bait while catfish fishermen use crawfish up to ½ ounce.

Several species of crawfish are grown for bait. The main considerations are that the species readily spawns in the late fall or very early spring and produces large numbers of eggs.

The extent of the bait market depends primarily on the weather. If the spring is cool and long, demand for crawfish for bait will be higher. The major factor to be considered by a crawfish producer aiming at the bait market is establishing contact with bait distributors or retail dealers. Normally, the season covers less than 10 weeks from April to June. The demand is very high during this period. Crawfish produced after

this period must be marketed in some other manner, usually at much lower prices. During peak demand times, prices paid to producers may be five times higher than after season prices.

Bait crawfish are caught by seining or trapping, held in screen containers in slowly moving water and then moved to the market in well-aerated water. Occasionally bait crawfish are hauled in containers without water, but they must be kept damp to survive. This practice is not recommended.

Food crawfish producers have a variety of market options. Most of the crawfish produced in the southern United States are sold to large processors. These processors "peel" the crawfish and extract the tail meat. This meat is then frozen and sold through supermarkets or restaurants. Generally, it is packed in one-pound packages. Recently, some of the large processors have established a market for prepared dishes featuring "Cajun" cooking, Swedish dishes (such as crawfish prepared in dill) or Spanish delicacies.

Some producers practice on-farm processing. This is prevalent in parts of Louisiana and is usually done when there is a temporary oversupply at local markets. All processing is done by hand, and the peeled tail meat is sold fresh to local consumers. The volume of this market is small and very seasonal. It depends on a clientele knowledgeable about crawfish dishes who prefers tail meat with most of the "fat" intact. This product can be frozen but usually becomes rancid after 30 days.

Many producers depend on local retail sales. There is an excellent market in areas where crawfish consumers are plentiful. Generally, crawfish are sold whole and live to supermarkets, seafood markets or restaurants. Crawfish are sold by the sack with weights varying from 10 to 50 pounds per sack. In the South, the preferred crawfish for this market is 3/4-1 ounce. They are usually marked by the number of crawfish per pound such as 24 count up to 16 count.

Delivering crawfish to local markets is time consuming and requires considerable marketing effort. Many farmers prefer to market through regional distributors. These businesses usually pick up the crawfish from the farmer, add frozen tail meat received from processors, and market their products along with other seafoods to restaurants or supermarkets. This option is particularly attractive when the market is a long distance from the primary production areas. Generally, these distributors encourage continuous marketing and delivery utilizing a variety of seafoods.

On-farm direct sales are the mainstay of most smaller operators in the Midwest, South and West. Crawfish are caught from the ponds and sold directly to consumers. Very little handling of the product is required. The crawfish are taken from the water and kept alive by placing them in sacks in a cold room, or placed in cages in running water, or confined in boxes packed with moist moss or sawdust. The advantage to producers is that they receive nearly the same price as in-town retailers, and the advantage to consumers is a fresher product that can be observed alive before purchase.

Recently, some producers and processors have begun to expand markets by purging, grading and moving to new market areas. Purging allows the animals to clean out their intestinal track and clean up their shells while being held in fresh, flowing water. This makes a better looking product that does not require washing and cleaning prior to boiling. Grading has a positive effect on crawfish marketing. Larger crawfish are preferred for many uses. Grading crawfish results in packages of uniform-sized product which is more appealing to the consumer.

In the past few years, soft crawfish (sometimes called soft-shelled crawfish) have been produced in quantity. This production practice takes advantage of the fact that crawfish must molt to grow. Young crawfish (about 25 to 30 per pound) are brought into a specially constructed building. They are encouraged to molt by changing the water temperature and feeding. When the crawfish molt, they are removed from the holding area and frozen for later sale. Soft crawfish are prepared by cutting off the head. This product can be cooked without the time-consuming process of peeling out the tail meat.

The strategy of moving to new market areas has proven beneficial to producers in the South and West. European and Scandinavian countries have proven to be excellent markets. Processors selling crawfish tail meat and microwave-ready "Cajun" dishes have targeted areas in the eastern United States.

New crawfish producers must consider marketing options when establishing production systems. If crawfish are sold to a processor, then that processor must be contacted to determine the size of the crawfish desired and the frequency of delivery. Most processors do not begin processing until January or later. Producers utilizing this option need to schedule flooding and harvesting to coincide with processing. For on-farm marketing, a long season is preferred. Production should peak in March or April before prices begin to fall due to intense competition. Very large crawfish are preferred in overseas markets, and production strategies include reducing the numbers of

crawfish per area of production, thus providing more available food per individual. This practice leads to more large crawfish though the total poundage produced is usually smaller. Premium prices are needed to offset the decreased production.

Soft-shell production requires a steady supply of young crawfish. This may mean filling a series of ponds at different times of the year.

ALTERNATIVE PRODUCTION SYSTEMS

Polyculture

Polyculture is not a common practice. Crawfish are so aggressive that most other crustaceans cannot survive in the same pond. Many fish species prey on the crawfish. Recent research indicates that minnows and carp can be grown with crawfish, but harvesting the fish is difficult. Most of the crawfish must be removed from the pond first. If fish and crawfish are removed from the pond by seining, the crawfish injure many fish. At this time, polyculture of crawfish is not economically feasible.

Intensive Culture

Several methods have been tried for growing crawfish in confined areas. They have generally been economically unsuccessful because of the cannibalistic behavior of crawfish. It is usually necessary to place individual crawfish in separate compartments. This inhibits water circulation and makes cleaning the production facility difficult. Some success has been achieved in spawning fairly large numbers of crawfish by placing the egg-bearing females into separate compartments. They are held through the first four or five molts then stocked in ponds. Survival is usually better than in the wild, and known numbers of equal-aged individuals are available for growout.

ECONOMICS

Stocking

Production costs vary from one section of the country to another. Stocking ponds is usually a one-time practice. From 60 to 100 pounds of crawfish are stocked per acre. Equal numbers of males and females are stocked. These crawfish should be 20 to 25 per pound in size and bought from a local producer if possible. Stocking is normally done in May in the South and in June or July in the Midwest. Another practice is to stock 5 to 15 young crawfish per square yard for grow out to market size. This practice requires stocking in March or April in the South and May or June in the Midwest. Cost of stockers is a minor part of total costs but may be as high as $100 per acre in some locations.

Feed

In Louisiana and Texas, the standard crawfish diet is rice forage. Rice is planted in July or August-fertilized and flooded in September or October. These cost average about $150 per acre. Costs for other types of forage are comparable. Commercially prepared feeds are available. These are generally more expensive but provide faster growth and higher production levels.

Energy Costs

Energy cost for pumping or other water movement is a major expense. Prices vary but often exceed $300 per acre over the entire season. Operation of equipment and labor for management are other costs but vary widely by area.

Harvest

Harvest costs usually are about half the total cost of most crawfish enterprises. This is because the harvest is conducted over a period of 3 to 8 months. All crawfish are not large enough to be harvested at one time. This means daily harvesting of the crawfish that are large enough to be sold. Crawfish are harvested by using baited traps set at about 20 traps per acre. Costs of labor for harvesting and bait will depend on the level of harvesting practiced but may cost from $0.08 to $0.28 cents per pound of crawfish harvested.

Hauling

Hauling costs depend on the distance from the farm to the holding facilities and to the eventual market. Normally, these are minor except for distributors who service large areas.

Advertising

Advertising is a necessary cost for farmers selling on the farm. Word of mouth advertising is usually not adequate. If crawfish are marketed through a processor, advertising costs to the producer are negligible.

REFERENCES AND ADDITIONAL INFORMATION

Primary sources of information on crawfish production include local county Extension agents, the Soil Conservation Service, the United States Department of Agriculture and your state game and fish agencies.

If you are a new or prospective crawfish farmer, not only will you need information concerning production management techniques, you may also need information concerning processing, marketing, economics, financial assistance, disease diagnostic services, water quality analyses, aquatic weed control, local and state laws and regulations, site selection and development, etc. In some areas, locating this information can be difficult. The following are possible sources of information or assistance.

1. The county Cooperative Extension Service office, usually listed under "County Government" in the telephone directory, can provide assistance. County Extension agents are employees of land grant universities. The county agent may assist you directly or draw upon the experience and training of a university expert or refer you to some other state or federal agency who can provide you with the information or service you need.

2. In the coastal and Great Lake states, land grant universities also have Sea Grant programs. In many of these states, marine advisory service specialists can provide needed information.

3. State game and fish agencies may also be a source of information on laws and regulations, production technology and diseases.

4. The United States Department of Agriculture Soil Conservation Service can assist in site selection and facility development. This agency is usually listed in the telephone directory under "federal" or "United States Government."

5. The United States Department of Agriculture's five Regional Aquaculture Centers can also refer you to state specialists for other resources specific to your needs.

Center for Tropical and
Subtropical Aquaculture
The Oceanic Institute Delta
Point
Waimanalo, HI 96795

Southern Regional
Aquaculture Center
Branch Experiment Makapu'i
Station
P.O. Box 197
Stoneville, MS 38776

North Central Regional
Aquaculture Center
Room 13 Nat. Res. Bldg.
Michigan Statw University
East Lansing, MI 48824-1222

Western Regional
Aquaculture Consortium
School of Fisheries, WH-10
University of Washington
Seattle, WA 98195

Northeast Regional
Aquaculture Center
University of Massachusetts-Dartmouth
Research 201
North Dartmouth, MA 02747

6. The United States Department of Agriculture National Agriculture Library is the National Aquaculture Information Center. It provides informational services on aquaculture. The address is:

U.S. Department of Agriculture
Aquaculture Information Center
Room 304 National Agriculture Library
10301 Baltimore Boulevard
Beltsville, MD 20705

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