

**Description:** The module consists of the following four problem areas;

**Module:** Crawfish Farming

**Problem Areas:** Determining the Nature of Crawfish Farming  
Establishing and Using Growing Facilities for Crawfish  
Reproducing and Rearing Crawfish  
Harvesting and Marketing Crawfish

**Objectives:** The objectives for each problem area are given below:

- A. Determining the Nature of Crawfish Farming
  - explain the scope of crawfish farming in the United States
  - describe characteristics of crawfish
  - explain the nature of crawfish farming
  - list and describe factors in deciding whether to produce crawfish
  - describe production systems used in crawfish farming
  - describe the kinds of crawfish produced
- B. Establishing and Using Growing Facilities
  - describe facilities needed to raise crawfish
  - explain design considerations with crawfish ponds
  - describe water requirements for crawfish farming
- C. Reproducing and Rearing Crawfish
  - describe management practices to encourage crawfish reproduction
  - describe how feed is provided for crawfish
  - describe how to keep crawfish healthy
  - describe special considerations with soft-shell crawfish
- D. Harvesting and Marketing Crawfish
  - explain harvesting
  - describe efficient harvesting procedures
  - explain crawfish grading
  - explain functions in marketing crawfish
  - describe approaches in marketing crawfish

# Aquaculture Curriculum Guide

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Teaching Plan:

**Module:** Crawfish Farming - Section A

**Problem Area:** Determining the Nature of Crawfish Farming

**Estimated Time:** 6-9 hours

**Goal:** The goal of this problem area is to understand the nature of crawfish farming, to consider areas for producing crawfish, and to determine the scope of crawfish aquaculture in the United States.

**Learning Objectives:** Upon completing this problem area, students will be able to:

- explain the scope of crawfish farming in the United States
- describe the characteristics of crawfish
- explain the nature of crawfish farming
- list and describe factors in deciding whether to produce crawfish
- describe production systems used in crawfish farming
- describe the kinds of crawfish produced

**Resources:** The following instructional resources are needed to complete this problem area:

**Essential:**

**Transparencies.**

**Additional:**

**Crawfish Culture** (SRAC Publication No. 240).

**Crawfish Production Systems** (SRAC Publication No. 241).

**Crawfish Production: Harvesting, Marketing and Economics** (SRAC Publication No. 242).

The videotape "Crawfish Aquaculture in the South," produced by the Southern Regional Aquaculture Center and available through the Cooperative Extension Service in each state.

Any books, bulletins, or other materials on crawfish aquaculture. Examples include the following:

**Introduction to Aquaculture**, by Landau, Matthew, John Wiley & Sons, Inc., NY, 1992.

**Crustacean Farming**, by Lee, Daniel O.C. & Wickins, John F., John Wiley & Sons, Inc., NY, 1992.

**Aquaculture: An Introduction**, by Lee, Jasper S. & Newman, Michael E., Danville, IL, Interstate Publishers, Inc., 1992.

Journals, magazines, and other periodicals on aquaculture, especially those with articles on crawfish aquaculture.

## Content and Procedures

### Preparation (Interest Approach):

To develop student interest in this module, have students describe crawfish farming by asking what is crawfish farming. Make a list of the major descriptive terms on the chalkboard. Allow students the flexibility of offering suggestions about how crawfish farming is carried out.

Note any trends or similarities in the statements on the chalkboard with other aquaculture enterprises. Conclude the interest approach by indicating that crawfish aquaculture is similar to other aquaculture and production agriculture. Also indicate that it is different because the nature and needs of the crawfish vary from other animals.

### Presentation:

#### A. What is the scope of crawfish farming in the United States?

Use TM A1 to present the objectives for the problem area.

1. More crawfish are grown in the U.S. than any other crustacean.
2. An estimated 150,000 acres of land are used for crawfish farming in the U.S.

Use a map of the United States to show the locations of where crawfish are grown. Ask students if they have visited a crawfish farm. If so, ask them to describe what they saw.

- a. Louisiana is the leading state with 125,000 acres in crawfish farming.
- b. Other states and acreages are Texas, 5,000; Florida, 2,500; South Carolina, 1,000; Arkansas, 500; Mississippi, 250; and Alabama, Georgia, Maryland, and North Carolina with fewer than 100 acres each. Some crawfish are also grown in California, Wisconsin, Oregon, and Washington.
3. The total annual harvest weighs over 100 million pounds.

Have students calculate the total value of crawfish at \$.50/lb if 100 million lbs are produced.

4. Most crawfish are used for human food.

#### B. What is a crawfish?

Use a live specimen to show why the crawfish is a decapod or use TM A2 to illustrate its 10 legs. (Note that the pincers are considered to be legs. The drawing only shows one side of the crawfish.)

1. A crawfish is a 10-legged crustacean.
  - a. Animals with 10 legs are known as decapods.
  - b. Crustaceans are animals with outer skeletons that encase the body.
2. The desirable part of the crawfish for human food is the muscular part commonly called the tail. (A study of crawfish anatomy indicates that it is the end of the abdomen.)

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3. Crawfish are also known as crayfish, crawdads, and mud bugs. The preferred spelling is crawfish.
4. Mature crawfish weigh about 2 oz and may be 5 or so inches long.
  - a. Crawfish used for food should weigh about 1 oz or more, but some are eaten when they weigh only .5 oz.
  - b. Some wild species of crawfish, known as dwarf crawfish, may be mistaken for young of the desired species.

### C. What are the common species of crawfish?

Use TM A3 to list the common and scientific names of the species most commonly grown. Remind students that scientific names are written in italics. Bring examples of species to class and have students use reference materials to identify them.

1. Over 300 species of crawfish are found in the United States. Australia has about 100 species, while Europe has 10 and western Asia has 1.
2. Two species of crawfish have been widely grown in the United States:
  - a. The red crawfish, sometimes known as the red swamp crawfish, is most widely grown in the U.S. Its scientific name is *Procambarus clarkii*.
  - b. The white crawfish is also cultured in the U.S. and has a lighter color than the red crawfish. It is more likely to be grown in northern areas of the U.S. Its scientific name is *Procambarus blandingi acutus*.
  - c. A third species that has recently been farmed is the deep water crawfish, also known as the white river crawfish. Its scientific name is *Procambarus zonangulus*.

### D. What is the preferred habitat for crawfish?

Make a field trip to observe a crawfish farm. Study the kind of soil and other features of the land. Test the water in the crawfish pond to determine its pH. Use a meter or other test to determine the oxygen level in the water. Observe the vegetation available to the crawfish and find out if the farmer uses supplemental feed.

1. Crawfish naturally grow in shallow, weedy swamps and ponds.
2. Soils high in clay are preferred because of their ability to hold water.
  - a. The water should be free of pollution from industries and pesticides.
  - b. Some salt in the water is not detrimental.
  - c. A pH of 5.8-8.2 is satisfactory.
  - d. Crawfish must have water with oxygen level of 3.0 ppm or higher.
  - e. Crawfish eat vegetation and tiny plants and animals that live in the water.
3. Crawfish respond to different temperatures.

Locate the opening to a burrow in an area where the water supply has dried up. Note how the burrow is closed to retain water and protect the crawfish.

- a. Crawfish prefer water at 65-85°F.
- b. Crawfish go dormant when the water temperature drops below 45°F.

- c. Crawfish burrow into the earth if the water temperature goes above 88°F.
- 4. In a natural habitat, crawfish reproduce in the spring and grow through the summer and fall toward maturity. Some reach sufficient size for harvest by November.

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### E. What are the major external parts of a crawfish?

Show TM A2 again to locate the 3 sections of a crawfish. Locate the eyes, antennae, and structure of the mandibles

1. The body of crawfish is divided into 3 sections: head, carapace and abdomen. These sections are divided into 19 segments (known as somites) with 19 pairs of jointed appendages.
2. The head has the eyes, antennae, and mandibles.
  - a. The compound eyes provide good vision for the crawfish.
  - b. The antennae send and receive information from the environment.
  - c. The mandibles bite and tear food.
  - d. The head is fused with the carapace, which means that there is no movable joint between the two.
3. The carapace is similar to the thorax of insects.

Using a specimen or TM A2, study the arrangement of the carapace. Identify the appendages. Use TM A4 to show how the carapace of red and white river crawfish vary. (The white river crawfish has a space between the 2 halves of the carapace.)

- a. The 10 pair of appendages are attached to the carapace. These include the maxillae and millipeds, which are used in feeding, and 5 pairs of walking legs, known as pereopods.
  - b. The first pair of walking legs forms the strong pincer claws, known as chelae. They are used to grasp food and for protection.
  - c. The structure of the carapace provides for accurate identification of the red and white river crawfish. All crawfish have a carapace that is divided into halves. The white river crawfish has a space between the two halves of the carapace.
4. The abdomen is the thick muscular part of the crawfish that is used for food. It has 5 pairs of swimmerets and one pair of uropods.

Using a crawfish specimen or TM A5, locate the swimmerets, uropods, mandible, and telson. Observe how a crawfish in an aquarium or other water source uses the telson to move backward quickly .

- a. The telson is located between the uropods at the tip of the abdomen.
  - b. The telson and uropods form a fan that is used to swim backwards.
5. Hard exoskeleton: made of calcium and a mixture of chitin and modified protein.

Examine the exoskeleton of a crawfish. A molted skeleton might work well for this. Observe crawfish in an aquarium or other facility to determine stages of growth as related to molting. Examine a soft-shelled crawfish. Ask students why a grown crawfish no longer molts.

- a. Growing crawfish molt. Molting is the process of shedding the shell and forming a new one. Molting is necessary for the crawfish to increase in size.
  - b. A full-size crawfish no longer molts.

- c. After the shell has been shed, the crawfish remains without a shell for about 12 hours. It may double in size during this time. A new shell forms and hardens. Crawfish without shells are known as soft-shell crawfish.
- d. Crawfish molt about 11 times before they reach maturity.

6. Crawfish can regenerate lost body parts.

Note any crawfish in the lab that has lost an appendage. Observe each day for regeneration.

- a. Regeneration is the process of growing new parts if they are broken off.
- b. Pincers and other parts are likely to be lost after molting.

7. Crawfish vary in color, depending on the species.

Describe the colors of various crawfish found in the water of local streams. Observe young crawfish in an aquarium or other facility over a period of time. Note changes in color as well as the molting process.

- a. The coloring, known as pigment, is in the epidermis (outer skin) beneath the shell.
- b. Crawfish have colors that allow them to blend into their water environment.
- c. Juveniles (young crawfish) turn darker just before molting, which is one of the signs that molting is near.
- d. All crawfish tend to be the same color when cooked. Boiled crawfish are reddish orange regardless of their color before cooking.

F. What are the major internal parts of a crawfish?

Use TM A6 or the chalkboard to present the body systems of crawfish. Use TM A7 to show the internal structure of a crawfish. Dissect a crawfish to observe the parts of the digestive system. Determine the food items present in the system.

The internal parts form systems, much as in other animals. Crawfish have 7 body systems:

1. The digestive system changes food into simpler forms that the body can absorb. The digestive system has four major parts:
  - a. A two-chambered stomach grinds and crushes the food (found behind the eyes).
  - b. A midgut secretes enzymes that begin digestion.
  - c. The hepatopancreas is the major digestive organ and is called fat by some crawfish eaters.
  - d. The intestine extends through the abdomen and moves undigested food particles to the anus for excretion by the crawfish.
2. The circulatory system consists of a heart, arteries that carry blood to the vital organs and channels that carry the blood back to the heart.

Use dissection to observe the parts of the circulatory system of a crawfish.

- a. The crawfish has no veins.
  - b. Oxygen is absorbed by the blood from the gills.
3. The nervous system consists of a brain with 3 sets of nerve cells, known as ganglia.

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Locate the external sensory organ on a crawfish. These include the eyes, antennae, setae.

- a. Two nerve cords run the length of the abdomen.
- b. The compound eyes provide excellent color vision for the crawfish.
- c. Numerous setae (hairs) on the body provide balance and touch for the crawfish.

4. The respiratory system provides oxygen to the cells of the body through circulating blood.

Examine a crawfish specimen to locate the gills. View the gill structure using magnification.

- a. Gills are the organs responsible for taking in oxygen and giving off carbon dioxide.
- b. They are located outside the body under the carapace and are designed so that they can get oxygen from the air if the crawfish is out of the water. The gills must be moist in order to do so.

5. The excretory system rids the body of wastes.

Dissect a crawfish to observe the organs in the excretory system.

- a. A pair of kidney-like organs, known as green glands, located above the mouth, produce urine which is stored in a bladder and then excreted from the body.
- b. Wastes are also excreted through the gills in the form of ammonia.

6. The muscular system includes powerful abdominal muscles that make it possible to swim backward rapidly and muscles in other parts of the body, such as in the pincers, walking legs, mandibles, and stomach.

7. The reproductive system varies with the sex of the crawfish.

Use TM A8 to describe the sexual distinction between male and female crawfish. Determine the sex of several specimens of crawfish. Observe a female crawfish with eggs or young attached. Observe a newly hatched crawfish on a female. (A magnifying glass may be needed.)

- a. Female crawfish have ovaries located in the head beneath the heart. Oviducts lead from the ovaries to openings at the 3rd pair of walking legs.
- b. In mating, sperm are transferred from the male to a receptacle on the female's abdomen.
- c. After mating, the female goes into an underground burrow to lay 100 to 500 eggs.
- d. The eggs are fertilized after they are laid and are attached to the female's body with a substance known as glair. The eggs incubate on the female and the young remain attached to the female through 2 molts. They leave the female when they are able to care for themselves.
- e. Male crawfish have testes located in the head near the heart. The testes produce sperm. Paired sperm ducts lead to openings at the bases of the 5th pair of walking legs. The male assumes no responsibility for the care of the young crawfish.
- f. Crawfish eggs hatch in 2-4 weeks after fertilization.

G. What is the nature of crawfish farming?

Ask students to explain why it is important to grow crawfish at other times of the year. Use TM A9 to list the components of the cycle used in raising crawfish. Arrange for a crawfish farmer to serve as a resource person in class and explain the process used on his/her farm.

1. Crawfish farming is the culture of crawfish.
  - a. In the wild, crawfish are available during only part of the year.
  - b. Culturing crawfish makes them available at other times of the year.
  - c. Culturing crawfish also insure the consumer of a wholesome food that is not contaminated with dangerous substances.
2. Crawfish grow in a cycle that typically begins in the spring and ends in the late fall and winter when harvest is underway.
  - a. Adult crawfish are stocked in growing facilities (often rice fields) in the spring.
  - b. Crawfish prefer water that is about 8 inches deep. The water is drained off after a few weeks from June to August.
  - c. As the ground dries, the crawfish burrow into the earth and reproduce.
  - d. The field is reflooded in October and the crawfish emerge from the burrows.
  - e. The crawfish feed on the vegetation that has been grown on the field and grow rapidly.
  - f. Selective harvesting may begin in November and run through the following March, depending on the size of the crawfish.
3. The work in crawfish farming involves a variety of tasks:

Develop this list using TM A10 and/or input from students.

- a. Establishing and stocking the ponds.
- b. Growing vegetation for the crawfish to eat.
- c. regulating water levels.
- d. Supplementing the food available to the crawfish.
- e. Harvesting those that have reached adequate size. Harvesting is a major activity requiring labor and equipment.

### H. What factors should be considered in determining whether to produce crawfish?

Ask students to explain why starting a crawfish farm is a long-term commitment. (Land must be acquired, pond must be built, wells dug, etc.) Ask them to explain each consideration and describe the major points to study associated with each.

1. Careful consideration should be given to several factors before going into crawfish farming because of the financial investment that is required. The decision to raise crawfish is a long-term commitment of resources.
2. Good information should be obtained and the likelihood of success should be studied. Consider the following 8 factors and formulate an answer for each of them:
  - a. Education and training in how to raise crawfish are essential. Will people (labor) with the needed education and training be available?
  - b. Land capability should be studied. Land should be put to its best use. Will crawfish farming be the best use for the land?
  - c. Water facilities will be needed. Ponds may need to be constructed, wells dug, pumps and pipes installed and drainage systems put in place. Will adequate water facilities be available?
  - d. Adequate water must be available. The water must be of quality suitable for crawfish farming. Will plenty of quality water be available at an economical cost?

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Explain that some authorities suggest that water supply may be one of the biggest limitations in crawfish farming: 70-100 gallons/minute for each acre of pond will be needed.

- e. Equipment to raise the crawfish will be needed. This includes tractors, boats, traps, feeders and other equipment. Will the equipment be available?

Have students construct a bulletin board or poster that depicts the equipment needed for crawfish farming.

- f. Finances will be needed. Money will be needed for building ponds, providing water, buying adult brood crawfish, providing feed, harvesting, hauling, paying labor and other costs. Will adequate finances be available?

Invite a local banker to discuss financing a crawfish farm. Determine the current interest rate and project this to the cost of establishing and operating a crawfish farm.

- g. Harvested crawfish must be marketed. Without marketing, the farmer gets no return. Will a market be available?
- h. Crawfish producers must like the nature of the work. Will I like crawfish farming?

Ask students to explain why it is important for people to like their work.

### I. What crawfish production systems are used?

Ask students to explain what is meant by manipulating the life cycle of a crawfish.

1. The life cycle of crawfish can be manipulated to fit into the production of other crops on a farm.
  - a. Some of the crops provide forage for crawfish.
  - b. The other crops must be adapted to the soil and land used for crawfish farming.
2. The production systems used for crawfish culture involve natural or artificial systems.

Use TM A12 to outline the production systems used in crawfish farming. Take a field trip to study a marsh that is used for crawfish farming. If not used, study the marsh to determine the presence of crawfish and other aquatic life.

- a. The natural systems involve using marshes and other low areas that naturally collect water and provide a satisfactory environment.
  - b. Trees and other obstacles sometimes impair harvesting in natural areas.
  - c. Water control may be difficult, with flooding from creeks occurring during rainy seasons and complete drying out occurring during dry seasons of the year.
  - d. Providing good forage may be difficult.
3. Three kinds of artificial systems are used:
    - a. Natural marshes may be dammed up to form ponds.
    - b. Permanent ponds may be used strictly for crawfish growing.
    - c. Rotation ponds with rice and other crops may be used with crawfish. These typically involve using facilities designed with the culture of rice as first priority. Soybeans are sometimes included in the rotation.

Have a resource person from the local ASCS office discuss regulations that apply to using land for crawfish farming.

4. The production system that is used must consider the programs of the U.S. government and requirements of various agencies, such as the use of wetlands.

J. What kinds of crawfish are grown based on use?

Use TM A14 to outline the major uses made of crawfish. Have students visit a local bait shop for information on recreational crawfish, including price.

1. Demand varies for different crawfish products. Some farmers cater to small, niche markets.
2. Four major kinds of crawfish are grown based on their use:
  - a. Brood crawfish. These are sexually mature male and female crawfish that are used to stock growing ponds.
  - b. Hard-shell food crawfish. These are grown for human food and represent the largest share of the market.
  - c. Recreational crawfish. These crawfish are grown and used for bait to catch other fish.
  - d. Soft-shell crawfish. These crawfish are produced for marketing while molting and they don't have a shell.

**Review:**

Review by having students demonstrate their knowledge and understanding of the objectives of the problem area. Lead a discussion with students by asking them questions that cause them to explain the content related to each objective. Observe how students use the content in their supervised practice, and observe how students apply the content in the school's aquaculture laboratory.

**Application Activities:**

Application can be addressed in several ways by involving the students using the content of the problem area in their supervised experience program, in the school laboratory or as they enter crawfish farming.

**Evaluation:**

Evaluation should focus on the extent to which students achieved the objectives of the problem area. Student achievement of the objectives can be assessed during review and application as well as through specific evaluation. Example exam questions are attached.

## Objectives

- Explain the scope of crawfish farming
- Describe the characteristics of crawfish
- Explain the nature of crawfish farming
- Describe considerations in deciding to produce crawfish
- Describe production systems
- Describe the kinds of crawfish produced

TM A2

TM A3

## Common and Scientific Names of Cultured Crawfish Species

- Red crawfish:  
*Procambarus clarkii*  
(Also known as red swamp crawfish)
- White crawfish:  
*Procambarus blanding acutus*  
(Also known as white river crawfish)
- Deep water white:  
*Procambarus zonangulus crawfish*

TM A4

TM A5

TM A6

## Body Systems of Crawfish

- Digestive
- Circulatory
- Nervous
- Respiratory
- Excretory
- Muscular
- Reproductive

TM A7

TM A8

TM A9

## Crawfish Production Cycle

- Ponds stocked with adult broodfish in spring
- Water drained off in June to August
- Crawfish go into burrows where females lay eggs
- Pond is reflooded in October
- Crawfish come out of burrows
- Crawfish feed on forage and grow
- Selective harvesting begins in late November
- Harvesting continues until following spring

TM A10

## Functions in Crawfish Farming

- Establishing ponds
- Stocking ponds with brood crawfish
- Growing vegetation for crawfish to eat
- Regulating water
- Feeding (supplemental to vegetation)
- Harvesting

TM A11

## Factors to Consider With Crawfish Farming

- Labor supply - appropriate education
- Land capability
- Water facilities
- Water supply
- Equipment
- Finances - construct and operate
- Market availability
- Nature of the work

TM A12

## Production Systems Used With Crawfish

- Natural:  
Marshes & low areas that collect water  
Water control is difficult  
Trees & other obstacles present problems  
Economical to use
- Artificial:  
Constructed to raise crawfish  
Expensive to build  
Designed especially for crawfish farming

TM A13

## Kinds of Artificial Crawfish Systems

- Natural marshes that are dammed
- Permanent ponds used only for crawfish farming
- Rotation ponds used with rice and other crops

TM A14

## Major Kinds of Crawfish Grown Based on Use

- Brood crawfish
- Hard-shell food crawfish
- Recreational crawfish
- Soft-shell food crawfish

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Quiz for Section A

Name:

Date:

Quiz on Determining the Nature of Crawfish Farming

Directions: Answer the following questions in the space provided. Be sure to spell correctly and provide the most complete information you can.

1. What is the scope of crawfish farming in the U.S.?
2. What is a crawfish?
3. What species of crawfish are farmed? (List common and scientific names.)
4. What is the preferred natural habitat of crawfish?
5. Draw a crawfish and label the 3 segments, uropod, telson, pincers eyes, antennae and walking legs.
6. What are the major body systems of crawfish? Describe the functions of each.
7. What cycle is involved in the production of crawfish? When does it begin and end? What functions occur in the cycle?
8. What factors should be considered in determining whether to go crawfish farming?
9. What 3 artificial systems are used to raise crawfish?
10. What kinds of crawfish are grown based on use?
11. What is molting?
12. What is regeneration?

### Key for Section A

1. Crawfish farming involves 150,000 acres in the U.S. Much of farming is in Louisiana. Other states include Texas, Florida, South Carolina, and Arkansas.
2. A crawfish is a decapod crustacean.
3. The predominant farmed species is the red crawfish (*Procambarus cambarus clarkii*). Two white species are farmed: white and red crawfish (*Procambarus blanding acutus*) and deep water (*Procambarus zonangulus*).
4. The preferred natural habitat of crawfish is shallow, weedy swamps and ponds. The water should have a pH of 5.8-8.2, with 3.0 ppm oxygen or higher. In addition, crawfish prefer water that is 65- 85°F.
5. The drawing should show 3 body segments as well as major appendages on each. The segments and appendages should be labeled.
6. The major body systems of crawfish are digestive system (changes food into forms the body can use); circulatory system (carries blood with oxygen to all parts of the body); nervous system (provides sensation with environment and for body balance); respiratory system (provides oxygen to the cells of the body); excretory system (rids the body of wastes); muscular system (provides for body movement); reproductive system (varies by sex of crawfish, but produces young).
7. The crawfish production cycle begins in the spring when adult and female crawfish are stocked in growing ponds. The water level is lowered to get the crawfish to burrow and reproduce. Water level is raised to get them to come out of the burrows grow. By late fall, some of the young crawfish have grown sufficiently for harvest to begin. Most harvesting is complete by late spring and the cycle starts over again.
8. The factors to consider in determining whether to go into crawfish farming are the following: education and training of manager and labor; land capability; water facilities; water supply; equipment; finances; market availability; and preferences about the nature of the work by the farmer.
9. The 3 artificial systems used to raise crawfish are natural marshes dammed to form ponds; permanent ponds used solely for crawfish farming; and rotation ponds used with other crops.
10. The kinds of crawfish grown based on use are brood crawfish, hard-shell food crawfish, recreational (bait) crawfish, and soft-shell crawfish.
11. Molting is the shedding of the exoskeleton as the crawfish grows.
12. Regeneration is regrowing a part that may be broken off, such as a pincer (claw).