Teaching Plan:

Module: Producing Catfish - Section E

Problem Area: Reproducing Catfish

Estimated Time: 10-20 hours

Goal: The goal of this problem area is to develop the competencies in reproducing catfish. Emphasis will be on developing skills in the spawning process, hatching eggs, rearing fry and fingerlings, and estimating the number of fry and fingerlings. (Students should study Section A on Producing Seed before beginning a study of this problem area.)

Learning Objectives: Upon completion of this problem area, students will be able to:

- describe the spawning process
- distinguish between male and female catfish
- identify sources of broodfish
- describe how to care for broodfish
- determine the number of broodfish needed
- select a method of spawning
- describe how to hatch eggs
- explain how to rear fry
- explain how to rear fingerlings
- estimate the number of fry and fingerlings

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

Essential: See pages 3-4 for full citations.

Third Report to the Fish Farmers, by Dupree & Huner.

Commercial Catfish Farming, by Lee.

Channel Catfish Production in Ponds, by Massor, Jensen & Crews.


Additional: See pages 3-4 for full citations.

The Catfish Book, by Crawford.


Ancestry and Breeding of Catfish in the United States, by Durham & Smitherman.
Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, ask students to explain the meaning of "seed." (The students should be referred back to their earlier study of the problem area on Producing Seed.) The definition that students should be led to understand is that "seed" refers to the "young, immature catfish that are used to stock growing facilities." Seed are known as fry or fingerlings, depending on the size and stage of maturity at which they are stocked.

Ask students to describe how the quality of the seed used in catfish farming compares to the quality of seed used by a corn farmer. (Good seed are essential in all areas of agriculture/aquaculture. Good seed grow and mature into the form desired by the farmer. Good seed grow efficiently and are resistant to diseases and other problems. Good seed don't die before reaching maturity.)

Have students explain the meaning of "percent germination" on the label of a package of corn seed. (*Percent germination* refers to the number of seed out of every 100 seed that will sprout and grow when given a suitable environment.)

Ask students to compare "percent germination" with the livability of catfish fry and fingerlings. (Note that a farmer who obtains fingerlings that have been poorly handled will suffer losses. This is much like the corn farmer who buys corn seed that have been improperly stored so that the viability of the seed has been reduced.)

Conclude the interest approach by explaining that certain practices can be followed in reproducing catfish to insure that the farmer receives quality seed.

Presentation:

A. What is the spawning process with catfish?

Show TM E1 and present the objectives of this module. Ask students to review the meaning of spawning. Have students define spawn. Have students calculate the number of eggs produced by female catfish for the following weights: 4 lbs (10,400), 6 lbs (15,600), and 3 lbs (7,800). Arrange for students to observe spawning behavior of catfish in the school lab or on a catfish farm.

1. Spawning is the production of eggs by the female and subsequent fertilization by the male catfish.
   a. The mass of eggs produced is known as a spawn.
   b. A typical channel catfish egg mass weighs 2-4 lbs.
   c. The number of eggs in a mass varies with the health, weight, and sexual maturity of the female catfish.
   d. The average number of eggs laid at one spawning is 2,600/lb of weight of the female fish, though the number may range up to 4,000 or more.
   e. The number of eggs produced by a female fish is calculated by multiplying weight in pounds by 2,500. (For example, a female weighing 5 lbs would produce an estimated 13,000 eggs.)

2. Catfish naturally spawn in the spring in water temperature of 70 to 85° F.

Show TM E2 to review the spawning process of catfish.

   a. Spawning may be later in the year if the spring is long and cool.
   b. Young catfish may spawn into September.
   c. Spawning will stop when the temperature of the water goes above 85° F.
3. In the wild, catfish spawn in streams and lakes. It occurs in water that is less than 5 feet deep.
   a. The male catfish prepares a nest in submerged stumps, holes in banks, and under logs. This
      involves packing and smoothing the mud.
   b. When ready, the female produces the eggs in a single mass that adheres together. The female
      may lay a few eggs, move aside for the male to deposit sperm over them, return and lay more
      eggs, with the male repeating the fertilization process.
   c. Spawning may require 4-6 hours or longer (sometimes as much as 20 hours) to be completed.
   d. When spawning has been completed, the male drives the female away and assumes a position
      over the egg mass. Fin movement and slight bumping of the egg mass by the male fan the eggs
      for 6-10 days when the eggs hatch.
   e. Upon hatching, the male may guard the nest for a week until the fry have lost their sac and feed
      for themselves.

B. What is the distinction between male and female catfish?

Show TM E3 to outline primary and secondary characteristics of sexual difference. In the lab, have
students dissect male and female catfish to observe the sex organs. Students should note the
location and appearance of the sex organs of the males and female. The ovaries of the female are
particularly easy to identify. Have students sex catfish using the genitals to determine sexual
difference. (Refer to sources of information on sexing catfish, such as Commercial Catfish Farming.)

1. Sexual distinction can be made using primary and secondary characteristics of sexual difference.
   a. Primary sex characteristics are the sex organs of male and female catfish. Since the organs are
      inside the body, dissection may be needed to determine the sex of a catfish. However,
      observation of the external sex organs (genitals) is fairly accurate in determining sex, especially if
      the catfish are near the time of spawning.
   b. Catfish are sexed by looking at the genitals. Two openings are present on the belly (ventral) side
      of the catfish: the anus and the genital opening. The opening toward the head is the anus, while
      that toward the tail is the genital opening.
   c. Male catfish have a genital opening that is raised and nipple-like in appearance.
   d. Female catfish have a genital opening that is rounded and flat. Immediately before spawning, the
      female genital opening may be swollen and reddish with folds of skin appearing on each side.

2. Secondary sexual characteristics may be more evident to the observer and includes the shape and
   proportion of the body.

Have students sex catfish bases on secondary characteristics and draw a profile of the secondary
sexual characteristics in their notes.

   a. Females tend to have a fuller abdomen and smaller head than the males.
   b. Males tend to have wider heads and smaller abdomens than females.

3. Several techniques are available in sexing catfish.
   a. Experienced catfish farmers can usually quickly and accurately determine the sex of a catfish.
   b. Techniques include using broom straws or pencils to determine the structure of the genitals.
      (These are recorded in various sources and can be used by students to gain skills in sexing
      catfish.)

C. What are the sources of broodfish?

Show TM E4 to outline characteristics of desirable broodfish. Ask students to explain meaning and
importance of genetic background.
1. Broodfish that are capable of producing large numbers of quality seed are most desirable.
   a. Genetic background is important in efficiency of food fish production.
   b. Seed that grow rapidly and have a good ratio of feed to gain are desired.
   c. Seed should result in food fish that provide a high dressing percentage of the most desirable cuts.
   d. Seed should be tolerant of stress and other factors in the growing environment.

2. Female broodfish should be capable of producing large spawns of viable eggs.

3. Broodfish that show strong secondary sexual characteristics are most desired by many farmers; however, selection on such a basis may not be a positive genetic selection procedure.

4. Broodfish should be obtained from reliable sources.

**Show TM E5 to outline the factors to consider in selecting sources of catfish.**

   a. Most farmers prefer to choose broodfish from improved stocks.
   b. The best source is a good hatchery.
   c. Some farmers grow their own broodfish and therefore are able to select on the basis of the characteristics they most want. (Occasionally broodfish from outside sources should be brought in to reduce inbreeding.)

5. Broodfish should come from farms that are as free as possible of disease.
   a. Diseases can be brought to a farm by broodfish that have a health problem.
   b. Proper sanitation procedures should be followed in bringing new broodfish to a farm.
   c. Young, well-fed broodfish are preferred.

6. Avoid wild broodfish. Those from domesticated stocks usually grow better, are more likely free of disease, and reproduce better.

**Ask students to explain why it is not a good idea to use wild fish for broodfish.**

7. Many farmers use broodfish for three breeding seasons (years); therefore, selection and management are important.

**D. How are broodfish managed?**

**Show TM E6 to outline procedures in proper management of broodfish.**

1. Broodfish must receive proper care throughout the year if they are to produce large, quality spawns during breeding season.

2. Providing proper nutrition keeps the broodfish healthy and results in larger spawns.

3. Keeping broodfish free of disease results in larger spawns.

4. Broodfish are moved to small holding ponds after the spawning season. (Holding ponds are usually less than 1 acre; often 1/4 acre is the preferred size.)
   a. The rate of stocking is based on the weight of the fish, but 600-1,000 lbs/acre is the maximum weight.
   b. Broodfish kept in small ponds are more likely to come for feed than those in larger ponds.
   c. Broodfish should be kept in different ponds to avoid a complete loss if a disease outbreak occurs in one pond. (Several can be stocked in each pond, depending on the size of the pond and number of broodfish on the farm.)
5. Broodfish should be fed year-round.

Have students calculate the amount of feed needed in a 1-acre holding pond that has 800 lbs of broodfish for 1 day when the water temperature is 58°F (800 X .03 = 24 lbs). Have students determine what is used by local fish farmers in supplementing commercial feeds for the broodfish.

a. Broodfish should be fed near 3.0% of body weight 5 or 6 days a week when the water temperature is above 55°F.
b. Broodfish should be fed about 1.0% of body weight 5 or 6 days a week when the water temperature is below 55° F. (Below 45°F, the rate may be 0.5% of body weight if they show evidence of feeding.)
c. Regular, commercial catfish feed is usually fed but is not considered adequate by many catfish farmers.
d. A dietary supplement of fresh or frozen meat (including fish) is often fed. Examples of supplements include beef heart, beef liver, chopped fish, minnows, and crawfish.
e. The rate of feeding meat to broodfish is 10-15% of the weight of the broodfish one time a week.
f. The rate of dietary supplement should be increased in March and April before the spawning season. This will insure that the fish are in good condition for spawning.

6. Broodfish should be kept free of disease.

Refer students to references that provide approved procedures in administering prophylactic treatments to broodfish. (Refer to Chapter 8 in Commercial Catfish Farming.)

a. A usual procedure is to treat broodfish for diseases and parasites each time they are handled. (Prophylactic treatments of dipping or holding in tanks is fairly easily done when moving broodfish.)
b. Never introduce unknown fish into a broodfish holding pond.

E. How many broodfish are needed?

Ask a student to review the number of eggs a female will produce at 1 spawning and the factors that determine the size of the spawn. Have students calculate the pounds of female broodfish needed to have the following number of fingerlings: 500,000 (192.3 lbs), 1,000,000 (384.6 lbs), and 750,000 (288.5 lbs).

1. The number of broodfish needed depends on the size of the female fish, their general health and nutrition condition, sexual maturity of the female, and the number of fingerlings desired.

2. The average number of eggs produced per pound of female is 2,600.
   a. Some will produce many more eggs and others fewer depending on various factors.
   b. The best measure is the pounds of female broodfish and not the number of fish.
   c. The number of pounds of females needed involves determining the number of fingerlings needed and dividing by 2,600. For example, if 300,000 fingerlings are needed, divide 300,000 by 2,600 and the result is 115 lbs of female broodfish. (Note: Some growers estimate only 800 fingerlings at time of stocking per pound of female broodfish.)
   d. Consideration must be made for mortality of the eggs, fry, and fingerlings.
   e. Farmers often have a few more pounds of broodfish than needed to compensate for losses.
   f. More females are needed because some may fail to spawn.

3. The number of pounds of male broodfish is roughly the same as the weight of the females.
   a. Some farmers use approximately 4 lbs of males for every 6 lbs of females.
   b. Males can be used to fertilize more than one spawn in one breeding season; therefore, fewer males than females are usually needed.
F. What are the 4 methods of spawning used?

Show TM E7 to outline the 4 methods of spawning.

1. Natural spawning. This involves wild catfish spawning in streams and lakes.
   a. Natural spawning is not used by many catfish farmers. When hatched, the fry are usually lost.
   b. Using fry from wild fish provides an uncertain seed source and may introduce disease into a catfish farm.

2. Pond spawning. This involves the use of ponds and allowing pond the catfish to spawn natural with some modifications.

Tour a catfish farm to observe pond spawning. Have students determine the size of the ponds, number of broodfish in ponds, spawning containers used, and other practices. In the school lab, establish a spawning pond and spawn catfish. Review catalogs of fish farm supplies to determine the kind and cost of commercial spawning containers.

   a. Spawning ponds are usually 1 acre or smaller in size and have shallow water with a depth of no more than 3 feet.
   b. The number of female catfish stocked per acre is 20-50, depending on the hatching method. If the eggs masses are removed and hatched in a trough, 50 females can be stocked per acre. If the eggs remain in the pond for hatching, only 20 females are stocked per acre.
   c. The number of male catfish stocked per acre is equal to or less than the number of females. In open ponds, some farmers use a ratio of 4 males for 6 females.
   d. Artificial nests, known as spawning receptacles, are placed in the ponds. The nests are often no more than 3 feet deep and may be made of plastic buckets, ammunition cans, milk cans, or similar containers. The containers are placed around the edge of the ponds at intervals of 20-30 feet, with the opening toward the center of the pond.
   e. Spawning containers should be checked regularly; some farmers check them every day and other farmers check them every 2-3 days to determine if the fish are producing eggs.
   f. Eggs may be removed for hatching or allowed to remain in the pond. Most catfish farmers move the eggs to a hatchery for artificial hatching.

3. Pen spawning. This involves placing pairs of broodfish in pens in spawning ponds or flowing streams. (This method is not frequently used.)

Tour a farm that uses pen spawning. Construct spawning pens in the school lab and use spawning pens to spawn catfish.

   a. Ponds are often used so that disease problems are kept to a minimum.
   b. Pens typically range from 4-6 feet wide to 8-12 feet long.
   c. Pens are placed in water about 3 feet deep.
   d. A spawning container is placed in each pen.
   e. Pen spawning is often preferred because it allows for some control over the spawning conditions.
   f. Pen spawning allows the pairing of selected breeding stock.
   g. Spawning can often be delayed by keeping the males and females in separate facilities.
   h. Pen spawning provides evidence that a female has spawned.
   i. Spawning containers are checked daily and spawns may be moved to a hatchery for incubation.
   j. When confined, incompatible broodfish may fight and fail to spawn.
4. Aquarium spawning. This involves spawning catfish in aquaria ranging from 20-50 gallons in size.

Use an aquarium to spawn catfish in the school lab. Have students observe and record the behavior of the fish in the spawning process.

a. One pair of fish is placed in each aquarium.
b. This method is not used by catfish farmers, but is more suited to research activities.

5. Several factors should be considered in selecting a method of spawning.

Show TM E8 to list the factors in selecting a method of spawning.

a. Size of farm. The number of seed needed is a major consideration. Ponds are used for large numbers of eggs.
b. Skill of farmer. Some methods require greater skill in order for spawning to be successful. Pond spawning requires less skill and time than pens and aquaria.
c. Diseases. Seed from wild stock in streams or lakes may be diseased and of poor genetic quality.
d. Facilities. Farms with the facilities needed for a particular method may find it more economical to use what is available.

G. How are eggs hatched?

Show TM E9 to summarize the incubation of catfish eggs. Hatch a spawn in the school lab and have the students observe and record their findings in the development of the eggs. (They should record dates, times, water temperature, egg characteristics, and when hatching starts and is complete.)

1. Catfish eggs hatch in 6-10 days when water temperature is 70-85°F.
   a. Eggs hatch more rapidly in warmer water and slower in cold water.
b. Embryo development is indicated by the color of the eggs.
c. Newly laid eggs are yellow.
d. As the embryo develops, the eggs change from pink to red near hatching.

2. Eggs hatched in water that is too warm may result in deformed catfish.

3. Catfish farmers typically use one of two methods of hatching eggs:

Show TM E10 to summarize the 2 methods of hatching. Tour a farm that hatches eggs in ponds to determine the management necessary for the processed to be completed.

4. Leaving eggs in the pond for natural hatching is a practice followed by some farmers.
   a. This method may involve leaving the fry in the pond for growing or moving the fry upon hatching to a rearing facility.
b. Many farmers prefer to move the fry to a rearing pond.

5. Moving the eggs for artificial hatching is preferred by most catfish farmers.

Tour a hatchery to determine the procedures used in artificially hatching the eggs. Observe the equipment used and how it is operated.

a. Hatching eggs requires skill and careful attention to the incubation process.
b. Eggs may be moved to a hatching trough with baskets and paddle wheels that slowly turn, causing egg mass movement similar to that of a male fish in wild hatching.
c. A few hatcheries use air stone systems in the hatching troughs.
d. Careful management is essential to prevent disease problems and maintain water at the proper
temperature and oxygen level.

H. What are the 2 methods of rearing fry?

Tour a catfish farm to observe the rearing of fry. Determine the facilities needed, kind of feed used,
and the management practices followed in rearing the fry. Show TM E11 to summarize the 2 ways of
rearing fry. Invite a farmer or other resource person to discuss pond rearing and feeding fry.

1. Fry are the young, newly hatched catfish that are less than 1 inch in length.
   a. Fry have a yolk sac attached for 2 to 4 days, and sometimes longer, after hatching.
   b. At this stage, the newly hatched catfish are known as sac fry.
   c. The sac is the remains of the egg yolk and provides nutrition for the young fish.
   d. Once the yolk sac is gone, fry must be fed.

2. Pond rearing. This method of rearing has several deviations that involve rearing fry in a pond, as
   follows:
   a. The fry may be hatched in spawning ponds and moved to rearing ponds.
   b. The fry may be allowed to remain in the spawning ponds for growth.
   c. The fry may be hatched in a trough and moved to the rearing pond.
   d. A major problem with pond rearing is the loss of fry due to predatory insects and fish. Several
      control practices are available.
   e. Once the sac is gone, fry must be fed a fine meal at the rate of about 1% of weight each day.
      After a few days, the rate of feeding is increased to 4-5% a day. Commercial feeds of 28-32%
      protein are typically used, about 8% of the ration being provided by fish meal.

3. Trough (tray) rearing. This involves rearing fry in troughs that are specially made for the purpose.

Establish a rearing trough in the school lab and have students observe the development of fry and
manage the water in the troughs. Have students feed fry using commercial feed.

   a. Troughs are often preferred because of the control over the growing environment of the fry.
   b. Considerable skill is needed to successfully rear fry in troughs.
   c. Quality, flowing water should be used that has at least 6 ppm dissolved oxygen at a temperature
      of 78-82°F.
   d. Once the egg sac is absorbed, fry must be fed a quality feed. (Some nutrition can be obtained
      from the water in a pond, but none is available in a trough.)
   e. Fry will swim to the surface of water when the sac is absorbed.
   f. Feed of fine particle size with 28-32% (sometimes as high as 50%) protein should be fed. It is a
      good idea to feed on a schedule of 2-hour intervals.
   g. Young fry need what appears to be a very small amount of feed. Actually, the amount is a high
      percent of their body weight. The amount is increased as the fry grow as well as the time between
      feedings is lengthened to 6 hours.
   h. Fry are typically fed at the rate of 20% of weight each day; however, careful monitoring is needed
      to insure that feed is not wasted that the fry get enough.
   i. Fry may be moved to rearing ponds when they reach a length of 3/4 to 1 inch.
   j. Some farmers use a chemical treatment in troughs each day to control fungi and other pests.
   k. Scrubbing is also used to clean the troughs.

l. How are fingerlings reared?

Ask students to explain the term fingerlings. Tour a farm to observe the rearing of fingerlings. Show
TM E12 to summarize the rearing of fingerlings. Have students rear fingerlings in the school lab.
1. Fingerlings are catfish that range from 1 to 8 or 10 inches long.

2. Rearing fingerlings is a continuation from the fry stage.

3. Fingerlings are usually reared in ponds, known as rearing ponds, that are 1/4 to 5 acres in size.

4. Proper management is essential to produce quality fingerlings.
   a. Fingerlings are fed a complete ration of 28-32% or 32-36% protein at the rate of 3-10% of body weight each day depending on their size and water temperature.
   b. Quality water that has 6.0 ppm dissolved oxygen and a minimum temperature of 78-82°F is preferred.
   c. Fingerlings may be stocked at the rate of 20,000-150,000 or more per acre in rearing ponds. (The size desired is a function of feeding rate. Smaller fingerlings result when the rate of stocking is increased beyond 50,000. A stocking rate of 20,000-50,000 will result in the fingerlings reaching a length of 5-7 inches in one growing season under normal growing conditions.)
   d. Regular observation of fingerlings to check for disease and water problems are needed.

J. How is the number of fry and fingerlings estimated?

Ask students to discuss why and when it is necessary to know the number of fry or fingerlings in a trough, pond, or other water structure.

1. Farmers must frequently know the number of fry or fingerlings in a trough, pond, or other water structure.

2. Estimates of numbers are needed when feeding, stocking facilities, and selling fry or fingerlings. (Note: Accuracy in counting is very important to insure that treatments are properly administered, feeding is at the desired level, and that buyers and sellers get the proper value for their investments.)

3. It is impossible to count one-by-one large numbers of very small fish.

4. Procedures for estimating numbers can be used with some degree of accuracy.

5. Several techniques for estimating the number of fry and fingerlings are available:

Show TM E12 to outline methods used to count fry and fingerlings.

a. Weight of female broodfish: This method is used with small fry. It lacks accuracy but may be the best available method. Since female broodfish produce an average of 2,600 eggs/lb of body weight, multiply this number times the weight of the female fish to get an estimate of the number of fry. (This assumes that all eggs are fertilized and hatched.)

b. Volume of fry: This method involves counting the number of fry in a small container, such as a graduated test tube meshed strainer. Once the number is known, the fry can be quickly measured by emptying and filling the container. (A standard used by some growers is that a 1-cubic inch container will hold 500 sac fry, but there is considerable variation in this measure.)

c. Weight of fry: This method involves dipping the fry from the water and quickly weighing them on a small scale. (A standard is that there are 1,000 7-day-old fry/oz though the number may range from 750-1,800.)

d. Length-weight charts: This method is used with fingerlings and involves measuring the length of fingerlings and referring to a chart for the estimated weight of a certain length. For example, a fingerling that is 3 inches long weighs 0.01 lb. This means 1 lb has 100 3-inch fingerlings. (A length-weight chart is presented in Appendix A of Commercial Catfish Farming.)
Aquaculture Curriculum Guide

Review:

Review by having the students demonstrate their understanding of the objectives for the problem area. Call on them to orally provide explanations of the content of each objective. Not only is this an effective review, it also provides reinforcement of the learning and allows the teacher to note and correct deficiencies. Some application and evaluation activities also provide good review of the problem area on reproducing catfish.

Application:

Application can involve several approaches. A few examples are listed here. Arrange for students to apply the skills in reproducing catfish in the school laboratory or in their supervised experience programs. Interview a broodfish farm and hatchery manager to determine the practices followed in the reproduction of catfish.

Have students prepare a short technical report on the practices followed in reproducing catfish and prepare bulletin boards or posters that depict various areas in reproducing catfish, a project for the local science fair, the FFA agriscience program, or the local 4-H program.

Evaluation:

Evaluation should focus on the extent to which the students have achieved the objectives of the problem area. A few examples of ways to evaluate learning are listed below. Observe the performance of the students in the school laboratory or in their supervised experience programs. Observe the quality of products produced for the science fair or the FFA agriscience competition. Review the quality of the notes and other materials that the students keep of the class activities. Observe the performance of the students in preparing bulletin boards and posters on the various aspects of reproducing catfish. Example exam questions are attached.
Objectives

- Describe the spawning process
- Distinguish male and female catfish
- Identify sources of broodfish
- Describe care of broodfish
- Determine number of broodfish needed
- Select a method of spawning
- Describe how to hatch eggs
- Explain how to rear fry
- Explain how to rear fingerlings
- Estimate number of fry and fingerlings
Catfish Spawning Process

- Spawn in the spring
- Spawn in water 70-85°F
- Stop spawning if water goes above 85°F
- In the wild, male builds mud nest under logs, etc., in water less than 5 feet deep
- Female produces eggs
- Male produces sperm
- Spawning may take 4-6 hours or longer
- Male will guard nest and tend eggs until hatching
Catfish Characteristics of Sexual Distinction

- **Primary Characteristics:**
  - Refers to sex organs
  - Located inside body
  - Male has testes
  - Female has ovaries
  - Genital openings vary
  - Male is raised and nipple-like
  - Female is rounded and flat

- **Secondary Characteristics:**
  - Differences not associated with sex organs
  - Male has larger head and smaller abdomen
  - Female has smaller head and larger abdomen
Desirable Characteristics of Catfish Broodfish

- Good genetic background
- Female capable of large spawns
- Show strong secondary sex characteristics
Factors in Selecting Catfish Broodfish

- Use improved stock
- Disease free
- Young fish
- Well fed
- Avoid wild fish
Management of Catfish Broodfish

- Maintain in holding ponds
- Provide proper nutrition
- Use complete commercial feed
- Use dietary supplement of meat near spawning season
- Keep disease-free
Methods of Spawning Catfish

- **Natural:**
  Not used by many farmers

- **Pond:**
  Catfish spawn naturally in spawning ponds
  20-50 females per acre
  4 males to each 6 females
  Use artificial nests
  Check nests daily

- **Pen:**
  Pairs (male and female) placed in a pen
  Water is 3 feet deep
  Artificial spawning nest used in pen
  Allows pairing of selected stock
  Delay spawning by separating males and females
  Check nests daily
  Easy to determine which fish have spawned

- **Aquarium:**
  Involves using a 20-50 gallon aquarium
  One pair placed in each aquarium
  Not widely used by farmers
Factors in Selecting Spawning Method

- Size of farm
- Skill of farmer
- Disease prevention
- Facilities
Incubation of Catfish Eggs

- Hatch in 6-10 days in water 70-85°F
- Embryo development is indicated by color of eggs:
  New eggs are yellow
  Color becomes pink as embryo grows
  Red near hatching
- Deformed fish may result if water is too warm
Methods of Hatching

- Leave Eggs in Pond:
  For natural hatching
  Fry may be moved to rearing pond
  Fry may remain in pond

- Artificially Hatching:
  Move eggs to hatchery
  Hatching troughs with baskets, paddles, or air stones
  Skill and round-the-clock observation required
Rearing Fry

- **Pond:**
  Careful management to prevent loss of fry
  Feeding is essential
  Little gained from pond water

- **Pond Deviations:**
  Hatch in spawning pond
  Move fry to rearing pond
  Fry remain in spawning pond
  Hatch in trough/move to rearing pond

- **Trough:**
  Rear in troughs
  Careful water management is a must
  Proper feeding is essential
  Complete nutrition is required
  Must control disease
Rearing Fingerlings

- Usually in rearing ponds

- Feed 28-32% protein:
  Feed at rate of 3-4% body weight daily

- Stock at rate:
  20,000-150,000/acre for 5-7-inch fingerlings

- Careful management needed to control disease and prevent water problems
Estimating Numbers

- **Weight of Female Broodfish:**
  Used to estimate eggs and fry
  Average is 2,600 eggs/lb of female

- **Volume of Fry:**
  Count number in a small container
  Varies as fry grow
  Standard 1 cubic inch contains 500 sac fry

- **Weight of Fry:**
  Dip from water and quickly weigh
  Standard: 1,000 7-day old fry in 1 oz

- **Use Length-Weight Chart:**
  Measure length of sample of fingerlings
  Estimate total weight/number stocked
Quiz for Section E

Name:

Date:

Quiz on Reproducing Catfish

Directions: Provide the information to answer the following questions. Be sure to spell correctly and provide the most complete information you can.

1. Describe the following as related to the spawning of catfish:
   a. Number of eggs produced
   b. Water temperature
   c. Fish behavior in wild spawning

2. What are the primary and secondary characteristics of sexual difference of catfish?
   a. Primary
   b. Secondary

3. How does a catfish farmer distinguish between male and female catfish?

4. What factors should be considered in obtaining broodfish?

5. Describe the following in the management of broodfish:
   a. Holding ponds
   b. Feeding
   c. Disease

6. How does a farmer determine the number broodfish that are needed?

7. How many pounds of female broodfish are needed to have 600,000 fingerlings?
8. What methods of spawning are used? Briefly describe each.

9. What methods of hatching are used? Briefly describe each.

10. How are fry reared?

11. How are fingerlings reared?

12. What methods may be used to estimate the number of fry or fingerlings?
Key for Quiz - Section E

1. a. Number of egg produced. Varies with the health, weight, and maturity of female.
   b. Water temperature. Naturally spawn when water is 70-85°F; stop above 85°F.
   c. Fish behavior in wild spawning. Water is usually less than 5 feet deep. Males prepare nest by
      packing and smoothing mud. Female produces eggs in a single mass that adheres together.
      Male deposits sperm over eggs, guards, and fans egg mass.

2. a. Primary. Sex organs: determine by looking at genitals or dissection: males have genital
   opening raised and nipple-like; female opening is rounded and flat.
   b. Secondary. Females tend to have fuller abdomen and smaller head than males. Males have
      wider heads and smaller abdomens than females.

3. Some techniques include broom straws or pencils to determine structure of the genitals: experienced
   farmers can usually quickly and accurately determine sex.

4. Genetic background is important; they should be obtained from reliable sources, come from disease-
   free farms.

5. a. Holding ponds. After the spawning season, broodfish are moved to holding ponds.
   b. Feeding. Should be fed year-round: 3% of body weight, 5-6 days/week when water
      temperature is above 55°F. 1% 5-6 days/week if water temperature is below 55°F.
   c. Disease. Should be free of disease; treat for diseases and parasites each time the fish are
      handled.

6. Involves determining the number of fingerlings needed and considering other factors such as mortality
   of eggs, fry, and fingerlings;

7. 230.

8. a. Natural. Involves wild catfish spawning in streams and lakes.
   b. Ponds. Involves use of ponds: allows fish to spawn naturally , with modifications.
   c. Pens. Involves placing pairs of broodfish in pens in spawning ponds.
   d. Aquarium. Involves spawning catfish in aquaria from 20-50 gallons in size.

9. a. Leaving eggs in pond for natural hatching may involve leaving fry for growing or moving to a
   rearing facility.
   b. Moving eggs for artificial hatching; requires skill and careful attention to the incubation
   process.

10. Either by pond rearing or by trough rearing.

11. A continuation of fry rearing, they are usually reared in "rearing ponds."

12. a. Weight of female broodfish.
   b. Volume of fry.
   c. Weight of fry.
   d. Length-weight charts.
Teaching Plan:

Module: Producing Catfish - Section F

Problem Area: Rearing Food Fish

Estimated Time: 4-8 hours

Goal: The goal of this problem area is to develop competencies in rearing food fish. This will include selection of fingerlings as well as using alternative systems of rearing the food fish.

Learning Objectives: Upon completion of this problem area, students will be able to:

- describe how to select fingerlings
- explain pond production
- explain cage production
- explain raceway and tank production
- describe routine management in food fish production

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

Essential: See pages 3-4 for full citations.

Third Report to the Fish Farmers, by Dupree and Huner.

Commercial Catfish Farming, by Lee.

Cage Culture: Handling and Feeding Caged Fish, by Masser.

Cage Culture: Cage Culture Problems, by Masser.

Channel Catfish Production in Ponds, by Masser, Jensen & Crews.


Additional: See pages 3-4 for full citations.

The Catfish Book, by Crawford.


Note: Students should have studied Year One on the Fundamentals of Aquaculture before beginning the study of this module. If not, additional time and detail will be needed to help the students develop competencies in rearing catfish for food.
Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, ask students to describe how the production of chickens has changed over the years. (They may need some coaching to identify the changes. The major changes have involved more intensive systems of production. Rather than chickens being allowed to run free out of doors without pens, they are produced in various high-population houses and cages.)

Ask students to describe the role of the farmer as chicken production has changed. (Example: Chickens that were raised out of doors could eat insects, worms, parts of plants, seed, and other food items found in their environment. Farmers might provide a little supplementary grain at various times of the year. In most cases, much of what the chickens ate was found in the open areas where they lived. Today, chickens are raised in confinement and must receive a complete diet. The intensity of production has increased disease problems, which must be controlled. Today's chicken farmer must be much involved with the birds in order for them to survive and grow.)

Ask students to describe the role of the catfish farmer as the culture of catfish has become more intensive. (Example: The catfish farmer must monitor all aspects of the culture environment and provide complete nutrition. This is far different from the growth of catfish in low population intensities in ponds and streams where they could feed on naturally occurring plants and animals. With the intensive production systems that are used today, intervention by the farmer is essential for the fish to survive and grow. Food must be provided. Water quality must be monitored and corrected as needed. Diseases must be controlled. All aspects of the production process must receive attention!)

Help students to see the parallel between changes in poultry production and catfish farming.

Presentation:

A. What factors should be considered in selecting fingerlings?

Show TM G1 to present the objectives of this module. Ask students to explain the meaning of fingerlings and how fingerlings are made.

1. Fingerlings are the seed used by food fish farmers.
   a. Quality fingerlings are needed if the farmer is to efficiently produce a quality food fish.
   b. The crop produced can be no better than the seed used.
   c. Even with quality fingerlings, good cultural practices must be followed if a food fish crop is to be profitably produced.

2. Quality, 5-7-inch fingerlings stocked in the spring in ponds will grow to food-size fish by the fall if properly fed and managed. (The preferred size for catfish that go to processing plants is 1-1.5 lbs at harvest. Weights of 3/4 to 3 lbs are typical for food-size catfish.)

3. Growers may obtain fingerlings in two ways, and either can be satisfactory if criteria are applied to assure quality.

Ask students to name 2 ways of obtaining fingerlings and list benefits of each. Ask students to name farmers who grow their own fingerlings. Have students interview farmers who grow their fingerlings and determine why they do and the benefits they feel are gained from doing so.

   a. Farmers may grow their own fingerlings.
   b. This provides for greater control over the quality of the seed.
   c. Some farmers don't want the additional bother of having to grow fingerlings.
2. Farmers may purchase fingerlings from another farm.

Ask students to name farmers who buy their fingerlings from a fingerling grower and interview them to determine the kinds of experiences they have had with bought fingerlings.

   a. Fingerlings should be purchased only from a farmer who has the reputation of producing quality seed.
   b. The reputation of a fingerling grower can be determined by talking to food fish farmers who have obtained fingerlings from the grower and observing the production practices followed on the fingerling farm.

3. Several criteria to apply in selecting fingerlings for a food fish farm are as follows:

   Show TM F2 to list criteria to apply in selecting fingerlings for a food fish farm.

4. Uniform size. Fingerlings should be close to the same size to help insure that they are the same size when harvested as food fish.

Have students practice grading fingerlings in the school lab or in their supervised experience program. Have students construct and use a bar grader in the lab.

   a. Fingerlings should be graded before stocking in a pond.
   b. Even when the fingerlings are of uniform size, food fish will vary in size because they grow at different rates.

5. Uniform species. Fingerlings stocked in a pond or other growing facility should be of the same species.

Have students practice sorting fingerlings based on species in the school lab or in their supervised experience programs. Have students interview local farmers to determine kinds of trash fish they most often find in fingerlings.

   a. Good fingerling farmers follow management practices to insure that all fingerlings are of the same species.
   b. Trash fish should be culled from fingerlings before stocking in food fish ponds.

6. Healthy. Good health is essential if fingerlings are to grow.

Have students inspect a sample of fingerlings to determine their general health. Have them administer a prophylactic treatment to a batch of fingerlings as they are being moved.

   a. Fingerlings should have received proper nutrition and not be stunted in growth.
   b. Fingerlings should be free of disease.
   c. Fingerlings should be handled carefully to avoid injury and stress.
   d. When hauled, fingerlings should receive a prophylactic treatment.
   e. Proper sanitation should be followed with fingerlings.

7. Same-sex populations.

Arrange a tour of a catfish farm at harvest time. Select several fish, determine their sex, and weigh each one to determine if there is a difference in rate of growth for male and female catfish. (All fish in the sample should be the same age.)
a. Research has shown that male catfish gain up to 15% more weight in a given period of time than female catfish.
b. The practicality of same-sex fish populations with catfish has not been proven on the food fish farm. (It may be in the future.)

B. What practices are followed with pond production?

Show TM F3 to outline the 2 cropping systems that are used. Arrange to tour a farm that uses topping and discuss with the farmer how the process works. Establish a small pond in the school lab that uses topping.

1. Open ponds are the most common water facilities used to produce food catfish.

2. Two cropping systems may be used:
   a. Topping. This is a system that involves selectively harvesting catfish on the basis of size and adding more fingerlings to the pond.
   b. Harvesting involves using a seine with 1 3/8 to 1 5/8 inch mesh. (This allows catfish weighing less than 3/4 pound to escape back into the pond to grow to a larger size.)
   c. Approximately 1/3 of the fish in a pond are harvested at any one time.
   d. A few days after the partial harvest, fingerlings are added to the pond in a number equal to the number harvested. With topping, space is more efficiently used.

3. Clean cropping (or harvest) This system involves growing fingerlings to food-size fish and harvesting all of them at one time regardless of size.

Tour a catfish farm that uses clean cropping and interview the manager to determine how the systems works.

   a. With clean cropping, the fingerlings are typically put in the pond in the spring and harvested in the fall when there is a market available.
   b. Clean cropping allows for maintenance to be performed on the pond.

4. The system selected depends on the personal preference of the farmer and the management that is to be provided.

5. Stocking rates in open ponds depend on the level of management to be followed with the pond.

In the tours of the farms listed above, determine the stocking rates that are used. Interview the manager to determine the special management needed with various stocking rates. Show TM F4 to outline stocking rates.

   a. Ponds that will receive very little management should be stocked at no more than 750-1,000 fingerlings per surface acre. (At this rate, some feeding is required in order for the catfish to survive and grow.)
   b. Ponds that will receive good management of water and proper feeding can be stocked at the rate of 3,000-4,000 fingerlings per surface acre.
   c. Ponds that will receive considerable management of water and proper feeding can be stocked at levels of 5,000-8,000 fingerlings per surface acre.
   d. Fingerlings may be stocked in a any time of year; however, most farmers prefer to stock in the spring. Winter months are least preferable.

6. Water quality must be maintained for catfish to survive and grow.

Show TM F5 to outline water management.

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a. A dissolved oxygen (DO) concentration of 4 ppm or higher should be maintained.
b. DO must be monitored regularly. This is especially important in the warm seasons of the year when it should be monitored 24 hours a day.
c. Mechanical aeration is often needed to increase the DO level of water
d. Various cultural practices can be used to maintain DO at a satisfactory level.

7. Nitrogen compounds may cause water problems, particularly in ponds with a high stocking density. (Ponds with high stocking densities have proportionately more feces produced by the fish.)

Determine if the farms that are toured have experienced nitrogen compound problems, particularly with ammonia and nitrite.

a. Overfeeding may result in excess feed in the water. Both feces and feed contribute to the development of nitrogen compounds, but feces is more important as a source of problem. Five of every 6 lbs of feed becomes waste.
b. Ammonia problems are more likely to occur in warm weather in water with a high pH. The gills and kidneys of catfish are subject to damage in water with high concentrations of ammonia.
c. Nitrite problems are more likely to occur in cooler weather in water with a high pH. The blood of catfish which get sick and die of excess nitrite has a brown color.
d. Nitrate seldom causes problems in catfish ponds.
e. The formation of nitrogen compounds can be controlled by feeding at the proper level.

8. Weeds and plankton growth need to be monitored and appropriately controlled, and this is mainly by using appropriate feeding rates.

9. Off-flavors may develop in catfish as a product of the water environment in which they are grown.

While touring catfish farms, ask the manager about problems with off-flavors. If he/she has had these problems, determine what corrective actions were taken.

a. Samples of catfish should be checked for off-flavor before harvesting.
b. Though not well understood, off-flavors may be attributed to several factors in the water environment, including plankton, overfeeding, weeds, organic matter, chemicals, and feed.

10. Catfish must receive proper nutrition to grow.

Show TM F6 to outline feeding practices. During tours of catfish farms, determine the feeding practices that are followed. Have students calculate the amount to feed if there are 6,000 fingerlings/acre averaging 5 inches long in a 5-acre pond. (This involved referring to a length-weight chart to determine the weight of the fingerlings. (A 5-inch fingerling weighs 0.0321 lb, or 1,000 weigh 32 lbs. Therefore, 32 X 6 = 192 lbs of fingerlings/acre. 192 X .03 = 5.76 lbs of feed/acre. For 5 acres, 5 X 5.76 = 28.8 lbs feed would be needed for the pond.)

a. The water in catfish ponds provides little natural food to support fish growth.
b. Catfish should be fed at 1.75-3% of their weight each day provided the temperature ranges between 70 and 90°F.
c. A floating pellet feed of 28-32% protein is often recommended for catfish. (The floating pellet allows the farmer to observe the feeding behavior of the fish.)
d. Catfish should not be fed more than they will eat in 10 minutes.
e. Two feedings each day are preferable to one in the warmer months when the water temperature is above 79°F. The first feeding should be about 9:00 a.m., with the second before 5:00 p.m. (Many farmers prefer to feed by 2:00 p.m. because feeding later in the day may increase the chance of oxygen problems during the night.)
f. One feeding a day is sufficient when the water temperature is 70-79°F.
g. Feeding on alternate days is acceptable when the water temperature is 60-70°F.

h. Below 60 °F, feed when the fish come for food and only the amount they will consume.

i. Careful observation of fish behavior is important in feeding. Only feed the catfish as much as they will eat in 10 minutes.

Visit a catfish farm at feeding time to observe catfish behavior. Ask the manager to describe the different behavior patterns observed and what these meant with the fish.

11. Careful management must be given to all factors in the production of catfish in open ponds.

C. What practices are followed with cage production of catfish?

Tour a catfish farm that uses cages and determine how the cages are managed. Construct a cage in the school lab and use it in a pond for catfish production.

1. Cage production involves the use of cages to confine the catfish.
   a. Cages may be located in ponds, streams, or other bodies of water.
   b. Cages allow for isolation of the cultured fish into a small portion of the body of water.
   c. The culture environment in the cage can be controlled to some extent.
   d. The volume of fish produced with cages is no greater than the volume that the body of water could support if the fish were not caged.
   e. Cages are often used in water that is not easily seined.

2. Cages have sides, tops, and bottoms and float in the water.

Construct a cage in the school lab and use it in a pond for production of catfish. Have students prepare posters and/or bulletin boards depicting the use of cages in catfish production.

   a. Cages often have volumes of 1-8 cubic yards. (Dimensions of 3 feet wide, 3 feet deep, and 4 feet long will give a volume of about 1 cubic yard. The most common size is 8 cubic yards, which has dimensions of 6 feet wide, 3 feet deep, and 12 feet long.)
   b. A meshed material over a frame of metal, wood, or plastic confines the catfish. (Mesh sizes are typically 1/8 to 1/2 inch, small enough to keep the fish from escaping and keep trash fish out of the cage.)
   c. Cage design usually provides for a feeding ring so that the feed doesn't float away into the pond.

3. Stocking rates are typically 175-250 catfish per cubic yard. (This is 8-10 fish in a cubic foot.)

Have students calculate the number of fingerlings to put in a cage that is 3 feet X 3 feet X 4 feet when the fingerlings are stocked at the rate of 216 fish/cubic yard. (216 divided by 27 [cubic feet in a yard] shows that there are 8 fish/cubic foot. The number of cubic feet in the cage is found by multiplying 3 X 3 X 4 = 8 = 36. The number of fish to put in the cage is 36 X 8 = 288.)

   a. Fingerlings are usually stocked at a length of 5-7 inches.
   b. Most cage systems produce no more than 2,000 lbs of catfish per surface acre of water.
   c. Total poundage produced in cages is no more than could be produced in the open pond and is usually less because when DO problems develop, the caged fish have no way to seek out areas of higher DO concentrations.
   d. The per acre stocking rate must consider the wild fish and other organisms that may be in the water. These compete with the caged catfish crop for oxygen and contribute to water problems.
4. Proper feeding of catfish in cages is essential.

**Ask students to describe why sinking feed is lost from a cage.**

a. The complete nutrient needs of catfish must be provided.
b. Caged catfish are fed at much the same rate as catfish in open ponds.
c. A 32-36% protein complete feed in floating pellet form is used. (Sinking feed can go out through the bottom of the cage and be lost.)

5. Caged catfish are fed at the rate of 4-5% of weight in warm weather when first placed in a cage as fingerlings. This amount will be reduced as the catfish grow. (Without a proper feeding ring, feed is lost through the mesh of a cage.)

**Calculate the amount of feed to use with a cage holding 288 fingerlings that are 8 inches long. (Refer to a weight-length chart to know that nine 8-inch fingerlings are in a pound; therefore, by dividing 288 by 9 the total weight is 32 lbs of fish. The amount to feed is 32 X .04 = 1.28 lbs/day for the cage.**

a. Research has shown that 2 feedings a day produces more growth than 1 feeding. Of course, only half of the daily amount is fed at each feeding.
b. Only the amount that will be eaten in 30 minutes should be fed.
c. If the feed is eaten in 10 minutes or less, the amount fed should be increased slightly.

6. Few catfish are grown in cages because of poor growth, disease incidence is higher than in ponds, and it is easier for a poacher to steal the crop.

a. A potential grower should carefully study the use of cages before going into the business.
b. Most individuals experiment with a few cages before making large investments in cage catfish farming.

**D. What practices are followed with raceway and tank production?**

Tour a farm that uses raceways and/or tanks to grow catfish. Discuss with the manager the practices that are followed in managing the fish.

1. Raceways and tanks have some use in the production of food catfish.

a. With both, careful water management is essential.
b. Most raceway and tanks systems use water with considerable flow.
c. Some systems filter and recirculate the water; these haven't proven to be economical ways of producing catfish.

2. Raceways and tanks may have more application in fry and fingerling rearing than in food fish production. Some growers consider a round and 20 feet in diameter with water 2 feet deep, equivalent to a 1.5-acre pond as far as stocking rate goes.

3. The rate of stocking fish depends on the rate of flow of the water and how it is managed.

a. A typical rate of stocking is 40 catfish/gallon/minute of water flow if the fish are to be grown to a weight of 1 lb.
b. Higher stocking rates result in lower growth rates; however, total weight of the fish produced may be greater.

4. Providing a nutritionally complete feed is essential.

a. Feed with 32-26% protein and a high vitamin content is recommended.
b. The rate of feeding is approximately 3% of the weight of the fish each day.
c. The total amount fed in a day may be divided into several feedings, but it may be more practical to feed one time.
d. Catfish in raceways and tanks may be fed by hand or with automated systems.
e. A floating feed is recommended in tanks and raceways.

5. Proper management of raceway and tank systems is essential.

Show TM F7 to outline management of raceway and tank system.

a. Water quality must be continually monitored with steps taken to correct any problems.
b. Water temperature control may be needed.
c. Well water pumped directly into raceways and tanks may be too cool.
d. Heating water is expensive and cuts into profit.
e. Some sites have well water that is of the ideal temperature, but most don't. (About 80-85°F is best.)

6. Waste management must be built into the system. (High populations of catfish can produce large amounts of excrement.)

7. Water filtration and disposal must be an important part of the design of raceways and tanks.

8. Disease problems must be prevented. (A disease can destroy an entire fish population in a short time in a raceway or tank.)

E. What routine management should be followed with food fish production?

Show TM F8 to outline the major management practices in rearing catfish for food. Call on students to describe considerations in establishing a production system.

1. The production of catfish requires considerable attention to the maintenance of an environment favorable for their growth.

2. The routine management of a catfish farm producing food fish must address the following areas:
   a. Production system: A production system must be selected that is appropriate for the climate and available water and skill of the manager, in compliance with legal regulations, and profitable.
   b. Quality fingerlings: A quality food fish requires the use of good seed.
   c. Proper nutrition: Catfish require certain nutrients in order to grow, and these must be provided in the feed. Most food fish require a nutritionally complete feed that is 32% protein. Most farmers prefer to use floating pellets because feeding behavior can be more easily observed.
   d. Water management: Quality water is essential if catfish are to survive and grow efficiently. Areas to consider are dissolved oxygen, ammonia, nitrites, alkalinity, pH, hardness, plankton growth, weed control, prevention of off-flavors, and contamination with hazardous wastes.
   e. Disease control: Catfish must be free of disease if they are to survive and efficiently grow. Prophylactic treatments should be used where possible to reduce the chance of disease. Avoid stressing fish. Follow proper sanitation procedures when hauling fish. Isolate new fish for a while when introduced to a farm.

3. Catfish production requires regular and frequent monitoring of the water and fish.

On tours of catfish farms have the manager describe the monitoring that is necessary.

a. Most catfish farmers monitor water 24 hours a day during the warm summer months.
b. The use of water test equipment is essential for accuracy and proper diagnosis of situations.
c. The catfish are most often monitored by their feeding behavior.
Review:

Review by having the students demonstrate their understanding of the objectives for the problem area. Call on students to orally provide explanations of the content of each objective. Not only is this an effective review, it also provides reinforcement of the learning and allows the teacher to note and correct deficiencies.

Application:

Application can involve several approaches. A few examples are listed here. Arrange for students to apply the skills in rearing food catfish in the school laboratory or in their supervised experience programs.

Interview a catfish grower to determine the production systems used and the management practices that are essential for the farm to be successful.

Have students prepare short technical reports on various areas of rearing catfish for food. The students can provide oral reports in class on their topics.

Have students develop posters or bulletin boards that depict various areas in the rearing of catfish for food and prepare a project for the local science fair or for the FFA agriscience program.

Evaluation:

Evaluation should focus on the extent to which the students have achieved the objectives of the problem area. A few examples of ways to evaluate learning are listed below. Observe the performance of the students in the school laboratory or in their supervised experience program in the rearing of catfish for food.

Observe the quality of the bulletin boards, posters, written technical reports, and oral technical reports included as a part of the application activities.

Follow up on students as they enter aquaculture jobs upon the completion of high school, community college, or university. Example exam questions are attached.
Objectives

- Describe how to select fingerlings
- Explain pond production
- Explain cage production
- Explain raceway and tank production
- Describe routine management in food fish production
Criteria in Selecting Fingerlings

- Uniform size
- Uniform species
- Health
- Same-sex populations (research use only)
Cropping Systems With Open Ponds

- Topping:
  Selectively harvesting based on size
  Approximately 1/3 harvested at a time
  Adding fingerlings equal to number of fish harvested

- Clean Cropping:
  Stocking ponds with fingerlings of same size
  Harvesting all fish at one time regardless of size
  Restocking
Catfish Stocking Rates in Open Ponds

- Ponds With Little Management:
  750-1,000 fingerlings/acre

- Ponds With Some Management:
  3,000-4,000 fingerlings/acre

- Ponds With Considerable Management:
  5,000-8,000 fingerlings/acre
Water Management in Catfish Ponds

- Oxygen:
  Keep DO at 4.0 ppm or higher
  Monitor DO 24 hours a day in warm weather

- Maintain DO With:
  Cultural practices
  Mechanical aeration

- Nitrogen Compounds:
  Uneaten feed and feces contribute to problem
  More likely in warm weather
  Damages gills and kidneys
  Fish may be stressed and die

- Nitrite Problems:
  More likely in cool weather
  Causes brown blood and death

- Nitrate Form:
  Seldom a problem

- Control Nitrogen Problems by:
  Adding water low in nitrogen
  Do not overfeed
  Study water chemistry for additional controls

- Weeds and Plankton and Other Problems:
  Not as critical as oxygen and nitrogen
  Refer to references or authorities
Catfish Nutrition in Ponds

- Water provides little natural food

- Feeding Varies With:
  Water temperature
  Size and number of fish

- Use 28-36% protein commercial floating pellets

- Water 70-90°F:
  Feed at 3% of fish weight (fw) daily

- Water 60-70°F:
  Feed at 3% of fw on alternate days

- Water Below 60°F:
  Feed when fish will eat

- Always observe feeding behavior

- Never feed more than will be eaten in 10 minutes
Management Factors with Catfish in Raceway and Tank Systems

- Water quality maintenance
- Water temperature control
- Waste management
- Water filtration and disposal
- Disease control
Summary of Routine Management Practices With Food Catfish Production

- Production system
- Quality fingerlings
- Proper nutrition
- Water management
- Disease control
Quiz for Section 1.2F

Name:

Date:

Quiz on Rearing Food Fish

Directions: Answer the following questions in the space provided:

1. What are 2 ways for a food fish farmer to obtain fingerlings?
   a.
   b.

2. What criteria should be applied in selecting fingerlings for a food fish farm? Briefly explain each.

3. What two cropping systems may be used with pond food fish production? Briefly explain each.
   a.
   b.

4. What determines the stocking rates that can used in ponds?

5. What time of the year is preferable for stocking fingerlings in ponds?

6. What major water problems must be managed on a food fish farm?

7. What feeding practices should be followed with catfish in ponds being grown for food?

8. What are the major management practices in producing catfish in cages?

9. What are the major management practices in producing catfish in raceways and tanks?

10. What are the overall routine management areas that must be considered in rearing catfish for food?
1. a. Farmers may grow their own fingerlings.
   b. Farmers may purchase fingerlings from another pond.

2. a. Uniform size should be close to the same size to help insure that they are the same size when harvested as food fish.
   b. Uniform species. Fingerlings stocked in a pond or other growing facilities should be of the same species.
   c. Healthy good health. Essential if fingerlings are to grow efficiently.

3. a. Topping involves selectively harvesting catfish on the basis of size and adding more fingerlings to the pond: fish grow year round in the pond.
   b. Clean harvest. Involves growing fingerlings to food-size fish and harvesting all of them at one time regardless of size; allows for maintenance of the pond.

4. The level of management to be followed with the ponds.

5. Spring.

6. a. The (DO) dissolved oxygen level.
   b. Nitrogen compounds.
   c. Weeds and plankton growth.

7. Should be fed at 3% of their weight daily provided the temperature ranges 70-90°F; should not be fed more than they will eat in 10 minutes.

8. Proper feeding of catfish in cages is essential; only the amount of feed that will be eaten in 10 minutes or less should be fed.

9. Careful water management is essential: providing a nutritionally complete feed is essential; waste management must be built into the system.

10. a. A production system appropriate for the climate, water and management skill.
    b. Good quality food fish require the use of good seed.
    c. Most food fish require a nutritionally complete feed - 28% protein.
    d. Quality water is essential if catfish are to survive and grow.
    e. Must be free of disease if they are to survive and grow.
Teaching Plan:

Module: Producing Catfish - Section G

Problem Area: Preparing Catfish for Marketing

Estimated Time: 4-8 hours

Goal: The goal of this problem area is to develop the competencies in getting food catfish from the farm to the market. This will include the areas of harvesting, holding, grading, and hauling live catfish; dealing with off-flavor; and following good marketing practices.

Learning Objectives: Upon completion of this problem area, students will be able to:

- describe harvesting
- select a method of harvesting
- list precautions in harvesting catfish
- describe how to hold (store) live catfish
- explain how to grade catfish
- describe how to haul catfish
- explain the problem of off-flavor
- describe the role of the producer in marketing

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

Essential: See pages 3-4 for full citations.

Third Report to the Fish Farmers, by Dupree & Huner.

Commercial Catfish Farming, by Lee.

Small-Scale Marketing of Aquaculture Products, by Gilbert.

Sorting and Grading Warmwater Fish, by Jensen.

Additional: See pages 3-4 for full citations.


Transportation of Warmwater Fishes, by Jensen.

Transportation of Warmwater Fishes: Loading Rates and Tips by Species, by Jensen.
Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, ask students how something that is fragile is packaged for shipping. Have them name something that they have received that has been shipped a distance and describe how it was packaged. If they can't name something, ask them to describe how a television set is packaged for shipping (example: large box with shock-absorbing packaging materials).

Ask students to explain why fragile items must be packaged properly (to protect them from damage; to get them to you so that they operate properly; to insure that the exterior finish is not scratched or otherwise marred; and to prevent dissatisfied customers).

Ask students to tell about the first thing they do after receiving a package. (They open it and inspect for damage.) Ask how shipping catfish compares to shipping a fragile item such as a television set or clock. (Catfish are fragile and must be protected from damage; they must be kept alive; they must be kept free of injury; and stress must be kept to a minimum.) Ask students to tell about situations where catfish have been improperly shipped.

Presentation:

A. What is harvesting?

Show TM G1 to present the objectives of this module. Ask students to explain the meaning of harvesting. Ask them to explain why catfish should never be harvested until a buyer is lined up.

1. Harvesting food fish involves gathering or capturing catfish so that they can be sold.

2. Catfish swimming in a pond are of little value to the owner until they are gathered together for moving to a processing plant or other outlet.

3. Food fish are harvested when a buyer has been lined up, the fish have reached the right size, and they are not off-flavor.

4. Fish should never be harvested until a market outlet has been obtained.

5. A sample should be checked for off-flavor before harvesting is initiated.

6. Catfish farmers may harvest their crop following 2 general approaches:

Show TM G2 to outline 2 methods of harvesting food catfish. Determine if there are farmers locally who use custom harvesters. If so, have students interview them about their experiences with custom harvesting. Tour a catfish farm where a custom harvester is at work. Note the kind of equipment used, the number of people who are working, and the skills that the workers need.

7. Custom harvesting: This involves the farmer hiring an individual or harvesting crew to perform the actual harvesting operation.
   a. The farmer doesn't have to own the specialized harvesting equipment or employ a crew of workers to carry out the harvesting operation. (This cuts down on the investment required to go into catfish farming!)
   b. Since custom harvesters work for a number of different farmers, it is important to schedule them well ahead of time.
c. The charges for custom harvesting are based on a per pound rate for the number of pounds of fish harvested, often 3 cents a pound.
d. In some cases, the farmer may furnish a tractor, workers, and other items to assist with harvesting.

8. Farmer harvesting: This involves the farmer doing his or her own harvesting.

Tour a catfish farm when the farmer is harvesting it. Note the equipment used, number of workers, and the skills that are needed. Have students interview a farmer who harvests his/her own fish. Determine the kinds of experiences they have had, including why they don’t use custom harvesters.

a. The farmer must own all of the equipment needed and have employees who know how to efficiently harvest catfish.
b. Except for the very large farms, the harvesting equipment may be used only a few days each year, being idle the rest of the time.
c. Farmer harvesting allows the farmer to exercise more control over the time of harvesting and the procedures that are followed in the harvesting process.

9. Harvesting procedures vary with the system of production.
a. Catfish in tanks and cages are harvested differently from those grown in open ponds.
b. The catfish may be dipped out of cages and tanks with nets.
c. Cages are rarely strong enough to be lifted from the water with the fish in them.

B. What the 4 methods of harvesting are used?

Show TM G3 to outline the 4 methods of harvesting.

1. Hooking (angling): This involves using hooks with barbs that are baited to attract the catfish to bite the hook which, once in its mouth, sticks into the flesh of the mouth so that the fish is captured.
   a. Hooking has very little use on catfish farms in harvesting food fish, except in recreational situations.
   b. Hooking may be used to catch samples of fish, such as with testing for off-flavor.
   c. Recreational facilities allow the general public to use hooks to catch fish.

2. Draining: This involves removing the water from a pond so that the catfish are isolated in a small area (usually about 20% of the size of the pond).

Interview catfish farmers to determine the methods they use to harvest food catfish.

a. The catfish are captured in the harvest basin using seines and nets and lifted to a haul tank.
b. Draining has declined in popularity because better methods have been developed to capture fish in the open pond by seining.
c. As the water level is lowered, problems associated with the depletion of dissolved oxygen may occur. (The fish have a smaller volume of water and the demand for oxygen is not reduced until the fish are removed.)
d. Draining results in the additional expense of filling the pond for another crop of catfish.
e. Draining also results in potentially discharging water that pollutes other water, such as that in nearby streams.

3. Seining: This involves using a seine to harvest an entire pond without lowering the water level.

Tour a catfish farm when fish are being harvested with a seine. Note the procedures used with the seine, including how it is put around the pond, how it is pulled, the duties of the workers, and the equipment that is needed. Have students construct a price list for a mechanized seining system.
Refer to catalogs for equipment descriptions and price information. Ask students to prepare posters or bulletin boards that depict mechanized seining procedures.

a. The general notion with seining is that a seine is put around a body of water and pulled through it capturing the catfish and isolating them in a small area of the pond.
b. Mechanized seining procedures have made it possible for a small crew of workers to harvest a large pond of catfish.
c. Since the water level remains, problems of oxygen depletion are less likely to occur, but an aerator should be placed nearby.
d. Pond bottoms must be smooth so that catfish can't escape the seine by hiding in holes.
e. The seine must be properly operated so that catfish don't swim over or under the seine by seining.
f. As the water level is lowered, problems associated with the depletion of dissolved oxygen may occur. (The fish have a smaller volume of water and the demand for oxygen is not reduced until the fish are removed.)
g. Draining results in the additional expense of filling the pond for another crop of catfish.
h. Draining also results in potentially discharging water that pollutes other water, such as that in nearby streams.
i. Mechanized seining procedures have made it possible for a small crew of workers to harvest a large pond of catfish.
j. Since the water level remains, problems of oxygen depletion are less likely to occur, but an aerator should be placed nearby.
k. Pond bottoms must be smooth so that catfish can't escape the seine by hiding in holes.
l. The seine must be properly operated so that catfish don't swim over or under the seine back into the pond.
m. Procedures in using seines are fairly well described; however, individuals learn the procedures best by working with a seining crew.

4. Trapping: This involves placing traps in the water for capturing catfish.

Construct a fish trap in the school lab. Set the trap in a pond and observe what happens. (Trap design is presented in Commercial Catfish Farming.)

a. Some type of bait is usually placed in the trap to attract the catfish.
b. Traps have little use in catfish farming except those used to surround catfish as they are feeding.
c. Traps are less efficient in capturing the catfish in a pond but provide good results capturing small quantities for market.
d. Traps are more often used in harvesting wild catfish.

C. What precautions should be observed in harvesting catfish?

Ask students to explain the meaning of fragile as related to catfish. Show TM G4 to list the precautions to follow when harvesting catfish. Ask students to explain what each precaution means.

1. Catfish are fragile and can be damaged by harvesting processes

2. Several precautions should be followed in harvesting:
   a. Catfish should be checked for flavor. (Off-flavor catfish should not be harvested.) Off-flavor checks should be made before harvesting is begun. Catfish with off-flavor should never be harvested.
   b. Catfish should be harvested only if a market is available and adequate handling and hauling equipment are available.
   c. A processing plant must be on schedule to receive the fish.
   d. Appropriate lifting and hauling equipment must be available.
3. Catfish must have adequate oxygen and quality water to remain alive.

Arrange to tour the receiving area at a processing plant. Determine the quality of the fish as they arrive and relate the quality to the water condition in the haul tank.

a. Catfish must arrive alive at processing plant.
b. High densities of catfish in harvest basins, haul tanks, and other facilities require careful attention to oxygen level and other water quality factors.

4. Catfish should not be fed within 24-36 hours of harvesting. Withholding feed 24-36 hours before harvesting allows for feed to have moved through the digestive system and reduces water fouling with feces and disgorged food.

Invite a catfish farmer to serve as a resource person in class and describe how catfish are prepared for harvesting.

5. Catfish should be handled carefully to minimize damage to the fish.
   a. Rough handling can result in cuts, broken bones, and other damage to catfish.
   b. Damaged fish may not be acceptable in processing.

D. How are live catfish held?

Show TM G5 to outline how catfish are held.

1. Catfish must often be held before they are hauled, graded, or processed. (Holding is the same as storing while alive.)

2. Catfish may be held in several ways:

3. Live cars. This involves using a net bag in the pond to hold the fish.

Observe the use of a live car on a catfish farm.

a. A live car is attached to the seine so that the fish are guided into it for holding. (The opening of the live car can be closed to keep the fish from escaping.)
b. Live cars are good to use because there is no lifting of the catfish and they are subject to a minimum of stress, as compared to tanks and vats.

4. Tanks: Harvested catfish are often held in tanks, particularly while waiting to be hauled to a processing plant or after arrival at the plant.

Observe the holding of catfish in a tank in the school lab or on a catfish farm. Determine the practices that are followed to keep the catfish in good health.

a. Careful management of the water is essential.
b. Water problems that must be controlled are oxygen depletion, temperature, ammonia, and fouling.

5. Vats: Vats are much like tanks, but are typically stationary and constructed of concrete.

Observe the use of vats to hold catfish. (A processing plant is a good place for this.)

a. Vats are used to a limited extent on catfish farms to hold fish. (Unloading and loading is a step many farmers want to avoid.)
b. Processing plants often use vats to hold fish awaiting processing.

6. The temperature of the water in tanks and vats should be kept cool.
   a. Catfish headed for processing should be held at a temperature of 48-59°F, though it may be impractical to get such water.
   b. Water temperature is lowered by using cool water and/or adding ice.

E. How are catfish graded?

Ask students to explain grading as related to eggs, livestock, or other agricultural commodities. Show TM G6 to outline catfish grading. Construct a box suitable for grading food-size catfish. (Refer to various reference materials to determine the design and distance between bars for various size catfish.)

1. Grading is the process of sorting harvested food fish to insure uniformity of size, species, and quality.
   a. Size grading involves using devices that allow smaller fish to move out of the container and retain the larger catfish.
   b. Having all catfish of a near uniform size simplifies processing and allows for the efficient use of automated machinery in the processing plant.
   c. Uniform-size catfish result in filets and other products that are of uniform size.
   d. Boxes with slatted bottoms are frequently used to grade food fish. Not many farmers use this method of grading catfish.
   e. Some farmers use the topping production system, which allows smaller fish to pass through the seine and sock and remain in the pond.
   f. Many farmers harvest all of the catfish in a pond and let the processing plant sort by size. (This is a step that most processing plants find costly and one they would prefer not to do.)

2. Processing plants want to receive shipments of catfish that contain no trash fish.

Visit a processing plant to interview the manager to determine the most common trash fish that are in a batch of catfish.

   a. Sorting by species begins with spawning and fingerling selection so that the fish grown are of uniform size. (Feeding trash fish is costly and reduces the profit to the farmer.)
   b. Trash fish, turtles, snakes, and other undesirable species should be removed before hauling to the processing plant.
   c. Removing undesirable species involves hand labor which cuts into profit.

3. Grading to insure uniform quality occurs at several steps in catfish farming.

During a visit to a processing plant, interview the manager to determine the most common quality problems with catfish.

   a. It involves removing injured, diseased, and deformed catfish.
   b. Careful seining, lifting, loading, hauling, and unloading procedures minimize damage to catfish.
   c. Following approved disease control practices minimizes loss to disease.
   d. Using quality fingerlings, good nutrition, and water free of harmful chemicals helps reduce the chance of deformed catfish.
   e. Quality grading often involves hand labor to remove the undesirable catfish.

4. More attention is being given to grading by the catfish industry.

Ask students to explain why uniformity is important to a processor.
Producing Catfish

F. How are live catfish hauled?

Observe the loading of catfish for hauling to a processing plant.

1. Live catfish must be moved from the farm to the processing plant or other market outlet.
   a. Catfish going to processing plants must be kept alive and in good condition until they are processed.
   b. Catfish for recreational lakes must arrive in a good state of health so that they live in the water facility until caught by the sport fisher.

2. Food fish are hauled in tanks to the processing plant.

Develop a list of the hauling equipment needed to deliver quality food fish to a processor. Using catalogs and other sources of information, develop a price list of all items needed. Have students develop posters or bulletin boards that depict the proper hauling of catfish.

   a. The tanks are mounted on trucks or semi-trucks with trailers.
   b. Quality water free of chemicals should be used.
   c. Water temperature in haul tanks should never exceed 65°F, with 50-60°F being preferable.
   d. Water in a haul tank should not vary more than 5°F from the water where the fish have been if at all possible except with very warm pond water.
   e. Water must be oxygenated to keep the fish alive. (Oxygen levels may be maintained by using agitators or injecting pure oxygen into the water.)
   f. Catfish should not be fed within 24-36 hours of hauling to prevent fouling of the water with feces and digested feed.

3. Catfish are usually in a haul tank only a few hours.
   a. Longer than 8 hours requires special attention to water quality and quantity of catfish.
   b. The water in a tank should be changed every 24 hours if the catfish are in it that long.
   c. Three pounds of fish may be hauled per gallon of water if the water is properly managed.
   d. Catfish not used for food may receive a prophylactic treatment when hauled to prevent bacterial growth and disease.

G. What is off-flavor in catfish?

Ask students if they can describe the correct flavor of catfish and if they could detect flavor in cooked catfish. If available, bring off-flavor catfish to class for cooking and study. Have students describe the off-flavor.

1. Off-flavor is a problem that occasionally develops in catfish when the flesh of the fish has an undesirable odor and taste.
   a. The cause of off-flavor is usually associated with algae and bacteria in the water.
   b. Blue-green algae are often associated with off-flavor.
   c. Blue-green and other algae produce geosmin, which is a compound that they excrete more often in the summer.

2. Samples of catfish should be cooked and examined for off-flavor prior to harvesting. (Do not harvest off-flavor catfish!)

3. Researchers have found that catfish will lose their off-flavor in 7-10 days if held in tanks or vats with fresh flowing water.
   a. Some farmers add fresh water to ponds to help eliminate the off-flavor.

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b. Use only feeds that are known not to cause off-flavor.

H. What is the role of the producer in marketing?

Show TM G7 to define marketing. Have students prepare posters or bulletin boards that describe the role of the farmer in marketing.

1. Marketing involves getting catfish to the consumer in the desired product form.
2. Catfish farmers should know the market before rearing food fish.
3. Catfish farmers should produce the kind of fish that consumers will buy.
   a. Processors must take the catfish and convert them into a desired form.
   b. Wholesalers must get the product to the retailers in the desired form.
4. The catfish farmer should carefully study the market and make decisions accordingly.

Show TM G8 to outline the areas that a farmer should study when making decisions about marketing. Interview local catfish farmers to determine the time of the year they do most of their harvesting. Check with a local processing plant to determine the current price for catfish. Ask about different prices for different sizes of catfish. Determine if the current price represents a decrease or increase over that of the past few months.

   a. Determine the best time to harvest.
   b. The normal production cycle is such that many catfish are harvested in November through February.
   c. Prices to the farmer may be higher if the catfish are harvested at times of the year when the volume being harvested is lowest.
   d. This influences when the fingerlings are stocked in the growing facility.

5. Determine the preferred size of catfish.

   Interview a local processing plant manager to determine the preferred size of catfish.

   a. The preferred size in most processing plants is 3/4 to 1 1/2 lbs live weight.
   b. Other sizes may be preferred with roadside and recreational markets.

6. Determine the quality desired in catfish.

   Interview a local processing plant manager to determine the characteristics of high-quality catfish.

   a. Catfish of uniform size and species are preferred.
   b. Catfish should be free of disease and defects.
   c. Catfish should be the desired flavor.
   d. Avoid contamination of the catfish with pollution while being grown

7. Determine the volume that can be marketed through a particular channel.
   a. Large volumes of catfish can be used by processing plants.
   b. Recreational lakes and roadside markets can use a smaller volume of fish.
Review:

Review by having the students demonstrate their understanding of the objectives for the problem area. Call on the students to orally provide the information that demonstrates their mastery of the content. Not only is this a good way to review, it is an excellent way to provide reinforcement of learning as well as to correct deficiencies.

Application:

Application can involve several approaches. A few examples are listed here. Arrange for students to apply the skills in preparing catfish for marketing in the school lab or as a part of their supervised experience programs. Tour harvesting and processing facilities to observe the activities that occur, particularly as related to the role of the farmer in assuring that a product is of high quality.

Have students prepare a short written technical report on the preparation of catfish for marketing. This can also be given as an oral report in the class. Different students can be assigned different areas for reporting.

Have students prepare a project on harvesting, grading, or hauling catfish for the local science fair or the FFA agriscience program.

Evaluation:

Evaluation should focus on the extent to which the students have achieved the objectives of the problem area. A few examples of ways to evaluate learning are presented here. Observe the performance of students in the school lab or in their supervised experience program in aquaculture. Observe the quality of the posters, bulletin boards, science fair projects, and other products prepared by the students, and the performance of the students of the review of the objectives for this problem area. Example exam questions are attached.
Objectives

- Describe harvesting
- Select a method of harvesting
- List precautions in harvesting
- Describe how to hold catfish
- Explain how to grade catfish
- Describe how to haul catfish
- Explain the problem of off-flavor
- Describe the role of the producer in marketing
Two Approaches in Harvesting Catfish

- Custom Harvesting:
  Hire someone else to harvest the catfish
  Farmer doesn't own equipment
  Farmer doesn't employ workers

- Farmer Harvesting:
  Farmer does the harvesting
  Farmer owns equipment
  Farmer employs workers
Methods of Harvesting Catfish

- Hooking:
  Use baited hook
  Very few fish harvested by hooking

- Draining:
  Lowering water level in pond
  Ponds constructed with a harvest basin
  Expensive to refill pond

- Seining:
  Using a seine on an entire pond
  Ponds aren't drained
  Mechanized procedures available
  Most popular

- Trapping:
  Placing traps in water
  Used very little
Precautions in Harvesting Catfish

- Check for off-flavor
- Harvest only if market is available
- Use quality, oxygenated water
- Withhold feed 24-36 hours before harvesting
- Handle to minimize damage
Holding Catfish

- Holding is the same as storing

- Live Cars:
  Use large net bag to hold in pond
  Minimum of stress on fish

- Tanks:
  Used for harvested fish
  Careful water management needed

- Vats:
  Used for harvested fish
  Careful water management needed
Grading Catfish

- Insures uniform size, species, and quality

- Size Grading:
  Insures uniform size
  Uses automated processing efficiently
  Filets and other products are uniform size

- Species Grading:
  Removes trash fish and other species

- Quality Grading:
  Insures catfish are free of defects, disease, and injury
Catfish Marketing

- Getting catfish to the consumer in the desired product form
- Farmers must know what consumers want
- Processors need to convert fish into products consumer wants
Catfish Marketing

- Getting catfish to the consumer in the desired product form
- Farmers must know what consumers want
- Processors need to convert fish into products consumer wants
Areas a Catfish Farmer
Should Study in Marketing

- Determine best time to harvest
- Determine preferred fish size
- Determine quality desired
- Determine volume that can be marketed
Quiz for Section G

Name:

Date:

Quiz on Preparing Catfish for Marketing

Directions: Answer the following questions in the space provided.

1. What is harvesting?

2. What are the 2 general approaches used to harvest catfish? Briefly explain each.
   a.
   b.

3. What are the 4 methods of harvesting? Briefly explain each.
   a.
   b.
   c.
   d.

4. What are the 5 precautions that should be observed in harvesting catfish?
   a.
   b.
   c.
   d.
   e.
5. What are 3 ways of holding catfish?
   a. 
   b. 
   c. 

6. What are the 3 factors used in grading catfish?
   a. 
   b. 
   c. 

7. Explain the following areas in the hauling of catfish:
   a. Water temperature
   b. Aeration
   c. Feeding

8. What is off-flavor in catfish?

9. What 4 areas should be carefully studied by a farmer in marketing catfish?
   a. 
   b. 
   c. 
   d.
Key for Quiz - Section G

1. The gathering or capturing of catfish so that they can be sold.

2. a. Custom harvesting. Involves the hiring of an individual or crew to perform the actual harvesting operation.
b. Farmer harvesting. Involves the farmer doing his or her own harvesting.

3. a. Hooking. Involves using baited, barbed hooks attracting the fish to bite the hook, sticking in the mouth flesh, capturing the fish.
b. Draining. Involves removing the water from a pond so that the catfish are isolated in a small area of the pond.
c. Seining. Involves using a seine to harvest an entire pond without lowering the water level.
d. Trapping. Involves placing traps in the water for capturing catfish.

4. a. Off-flavor. Catfish with off-flavor should not be harvested.
b. A market and adequate handling/hauling equipment must be available.
c. Catfish must have adequate oxygen and quality water to remain alive.
d. Catfish should not be fed within 24-36 hours of harvesting.
e. Catfish should be handled carefully to minimize damage to the fish.

5. a. Live cars.
b. Tanks.
c. Vats.

b. Species grading.
c. Quality grading.

7. a. Water temperature. Should never exceed 65°F; 50-60°F is preferred. Should not vary more than 5°F from the water where the fish have been.
b. Aeration. Water must be oxygenated to keep fish alive by using agitators or by injecting pure oxygen into the water.
c. Feeding. Should not be fed within 24-36 hours of hauling to prevent fouling of the water with feces or disgorged food.

8. When the flesh of the fish has an undesirable odor and taste.

9. a. Determine the best time to harvest.
b. Determine the preferred size of catfish.
c. Determine the quality desired in catfish.
d. Determine the volume that can be marketed through a particular channel.