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WATER HARVESTING AND AQUACULTURE  
FOR RURAL DEVELOPMENT

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*OREOCHROMIS NILOTICUS* FRY AND  
FINGERLING PRODUCTION IN TANKS

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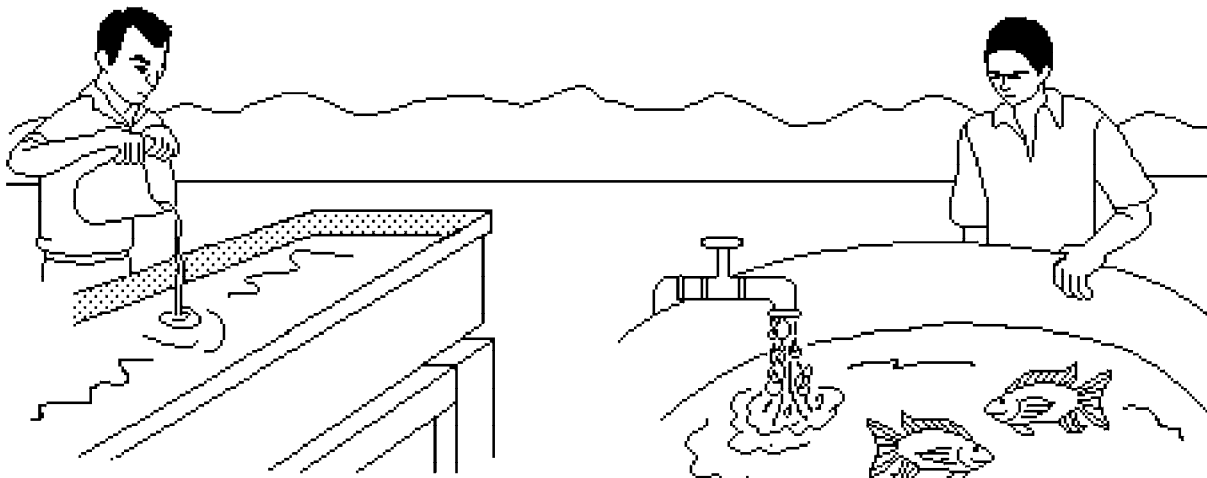
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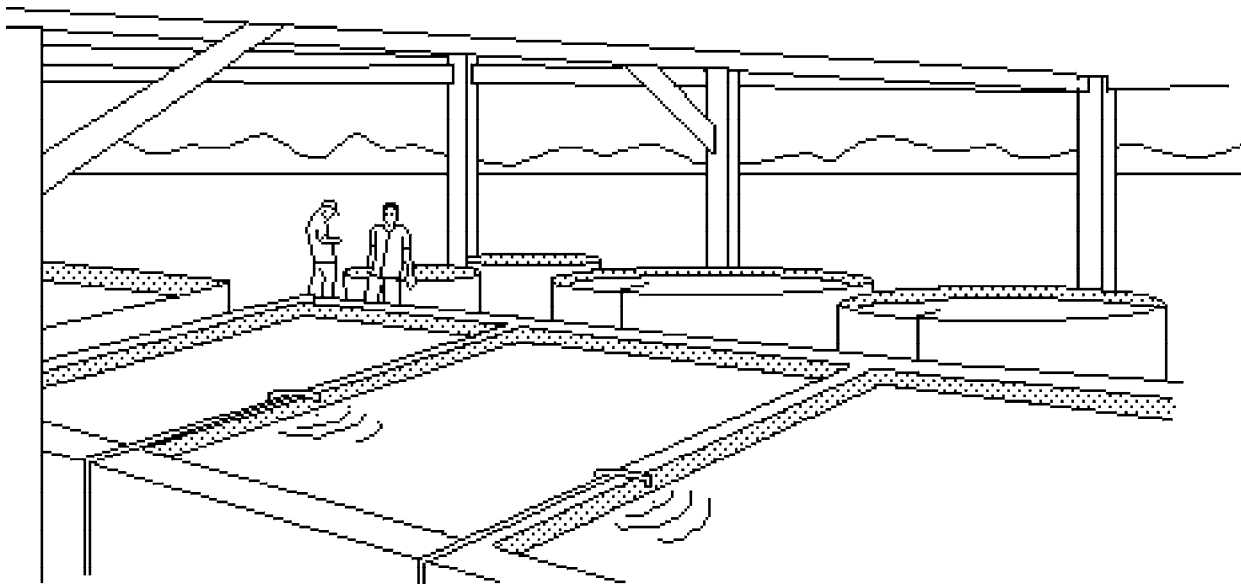
**Introduction**

Tilapia fry may be produced in square, rectangular or circular tanks made of wood, concrete, bricks, fiberglass, or plastic with individual water inlets and drains (Figure 1). Tanks may be expensive, but are common where space is limited, or where earthen ponds are impractical because of unfavorable topography. Tanks with a surface area less than 50 m<sup>2</sup> and a depth of 1 m are manageable, but commercial producers may prefer tanks of 100 m<sup>2</sup> surface area or larger. Monthly fry yield from tanks may range from 500 to 1,000/m<sup>2</sup> of tank surface area, but commercial hatcheries often produce up to 7,000 fry/m<sup>2</sup>/month, depending on the frequency of fry collection and management of brood fish.



Easy disease treatment.

Fish are easily observed.



Tank production can be large- or small-scale.

Figure 1: Tanks may be constructed from a variety of materials and in different shapes and sizes.

## Tank Placement

Tanks may be located in enclosed buildings, outside or under partial cover. Temperature is a major factor affecting tank location. Ideal spawning and rearing temperatures for *Oreochromis niloticus* range from 25 to 29°C. Tanks built outside may only be useable during the warm season in temperate climates. Tilapia will not spawn readily in water below 20°C and heating systems will be required if fish are spawned during cold months. Energy used to heat water will increase costs and may make fry production unprofitable.

Overheating is seldom a constraint for tilapia fry production, but where daily temperature becomes very high, partial shelters may be built over tanks. A roof is often built over tanks to provide laborers with a comfortable working environment. Expensive materials such as plywood, fiberglass or metal sheets may be used, but inexpensive palm branches or woven grass roofs are also functional. Windows of glass or plastic sheeting are often built into these roofs and allow sunlight to reach the tanks for some time during the day. Tank depth becomes important when culture is done under direct sunlight. A minimum water depth of 50 to 75 cm should be maintained to prevent drastic water temperature fluctuations in outdoor tanks.

## How does the system work?

Tanks may be used for all phases of fingerling production from spawning to final nursery. The following procedure outlines steps used in this system.

1. Tanks are stocked with adult brood fish weighing 100 to 300 g each. Four to 7 adults in a ratio of 1 male per 3 females are stocked per m<sup>2</sup> of tank surface area. The higher density is used for small brood fish and the lower density applies when brood fish weigh over 200 g each.
2. Feed brood fish at 2% of body weight daily during the breeding cycle. Pelletized or ground feed containing 24 to 30% crude protein is suitable. Outdoor tanks may also be fertilized with chicken manure and/or chemical fertilizer to maintain a phytoplankton bloom water visibility to a depth of 20 to 30 cm.

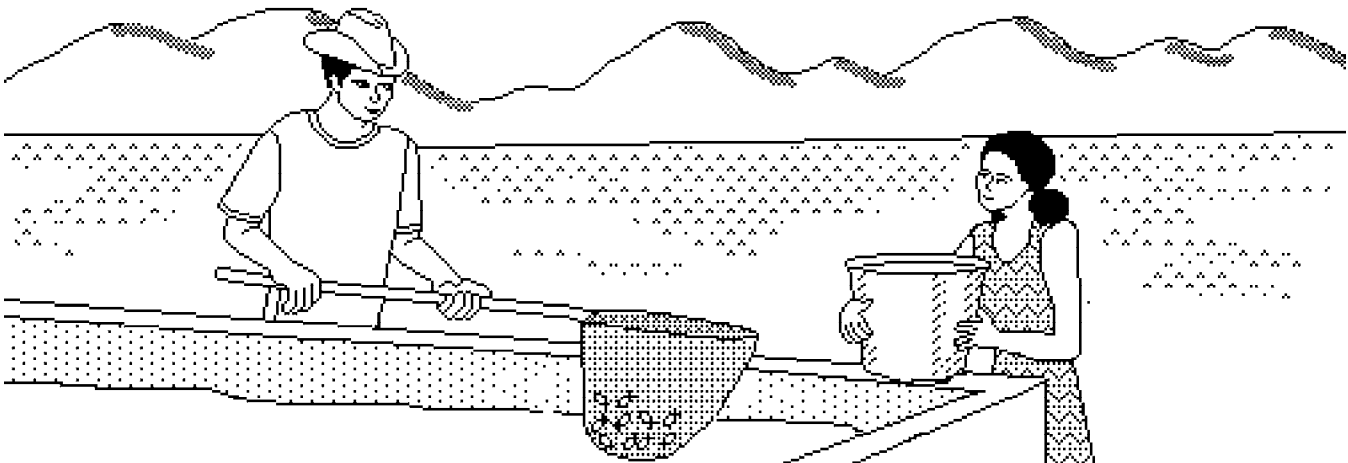


Figure 2: Collecting fry in a fine-mesh dip net.

3. Look for fry 10 to 11 days after stocking brood fish. Visually locate the fry schools and collect them daily in fine-mesh (1.5 to 2 mm) dip nets (Figure 2). After 21 days, brood fish are harvested, separated by sex and reconditioned for 2 weeks in separate tanks prior to restocking in breeding tanks. The cycle may be extended longer than 21 days if daily fry production remains high. However, cannibalism of small fry by larger fry often causes a serious reduction in fry production after 3 or 4 weeks. Reduced fry number is the signal to drain the tank and begin a new cycle.

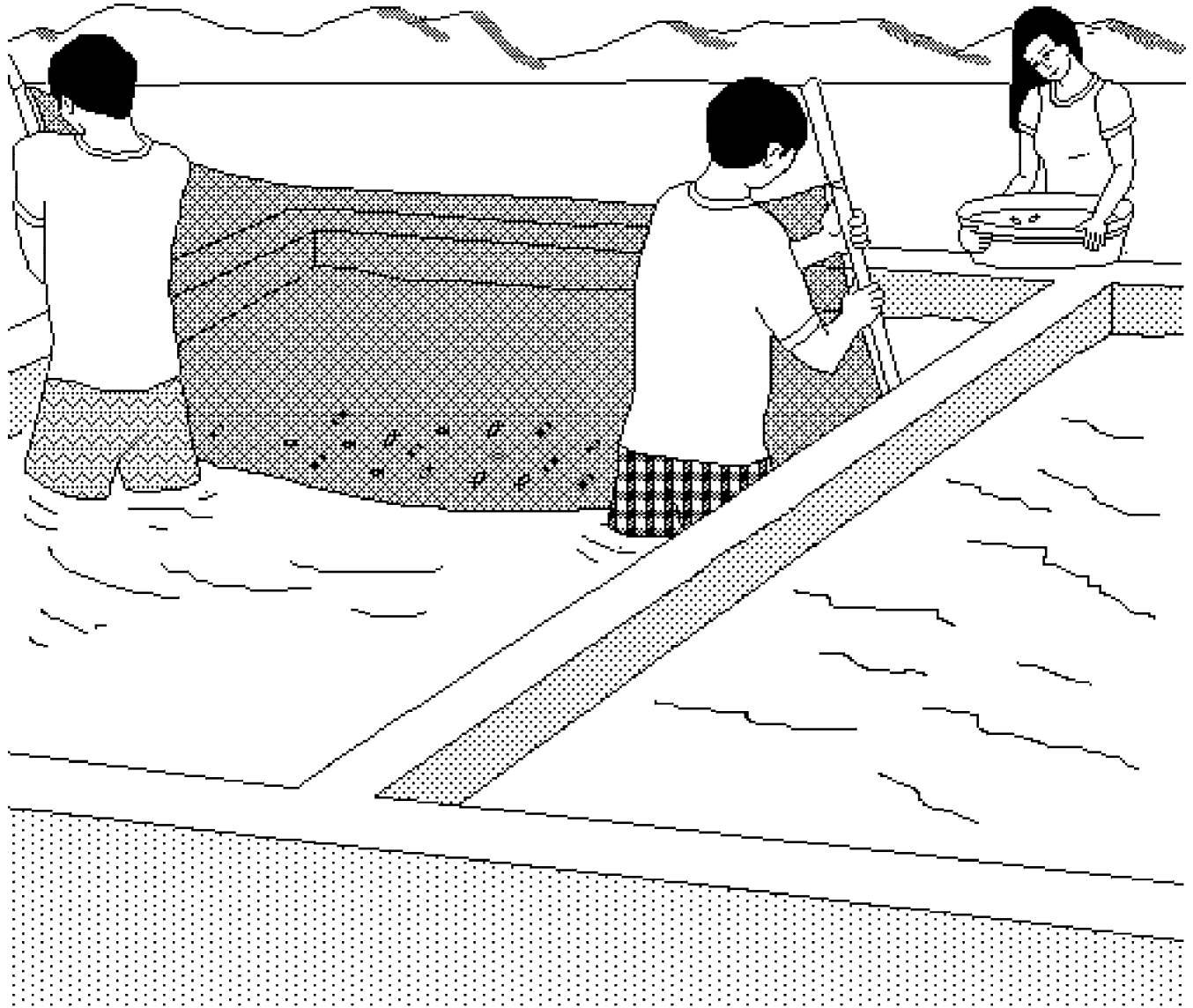


Figure 3: Removing fry from tank with mosquito-mesh seine net.

In tanks with a heavy phytoplankton bloom, fry may be difficult to see and remove with a dip net. Fry can be removed with a 1.5 to 2 mm mesh (mosquito-mesh) seine net carefully pulled through the tank every 3 to 4 days starting 10 to 11 days after stocking brood fish (Figure 3). The seine can be pulled just above the tank bottom so the brood fish can escape under the net.

Female brood fish carrying eggs may spit out their eggs if captured. The eggs die and fry production is reduced.

A third alternative is to wait for 17 days when water temperatures are 30°C, or 21 days at 25°C after stocking brood fish and then drain the tank to harvest the fry and brood fish. Lower the water level by 50% and remove the brood stock with a large-mesh seine to reduce damage to the fry which occurs if brood fish and fry are captured in the same net. Brood fish are separated by sex and reconditioned for 2 weeks in separate tanks prior to restocking in breeding tanks. See *Culture of Hand-Sexed Male Tilapia* in this series for a method of manually selecting male tilapia. *Oreochromis niloticus* females usually release fry from their mouths when captured, but the mouths of *O. aureus* and *O. mossambicus* should be inspected for eggs and fry. See *Reproductive Biology of Oreochromis niloticus* in this series. Fry in the tank can be collected with a mosquito-mesh seine or in special sumps built into the tank floor and removed with dip nets (Figure 4). Harvested fry are very delicate, and should be kept submerged in water as much as possible to avoid injury.

4. Transfer fry to primary nursery ponds, net enclosures, or tanks. Stock tanks at rates of 500 to 750 per m<sup>2</sup> of tank surface area plus 30 to 40% to compensate for probable mortality. A daily water exchange of 1 to 20% is recommended during fry nursing. A high water exchange may be needed near the end of the fry rearing period when accumulated waste products will degrade water quality. Provide newly collected fry a finely ground feed at the following daily rates for 3 weeks.

- a) 1st week - feed at 15% of the total body weight divided into at least 2 daily feedings.
- b) 2nd week - feed at 12% of the total body weight divided into at least 2 daily feedings.
- c) 3rd week - feed at 10% of the total body weight divided into at least 2 daily feedings.

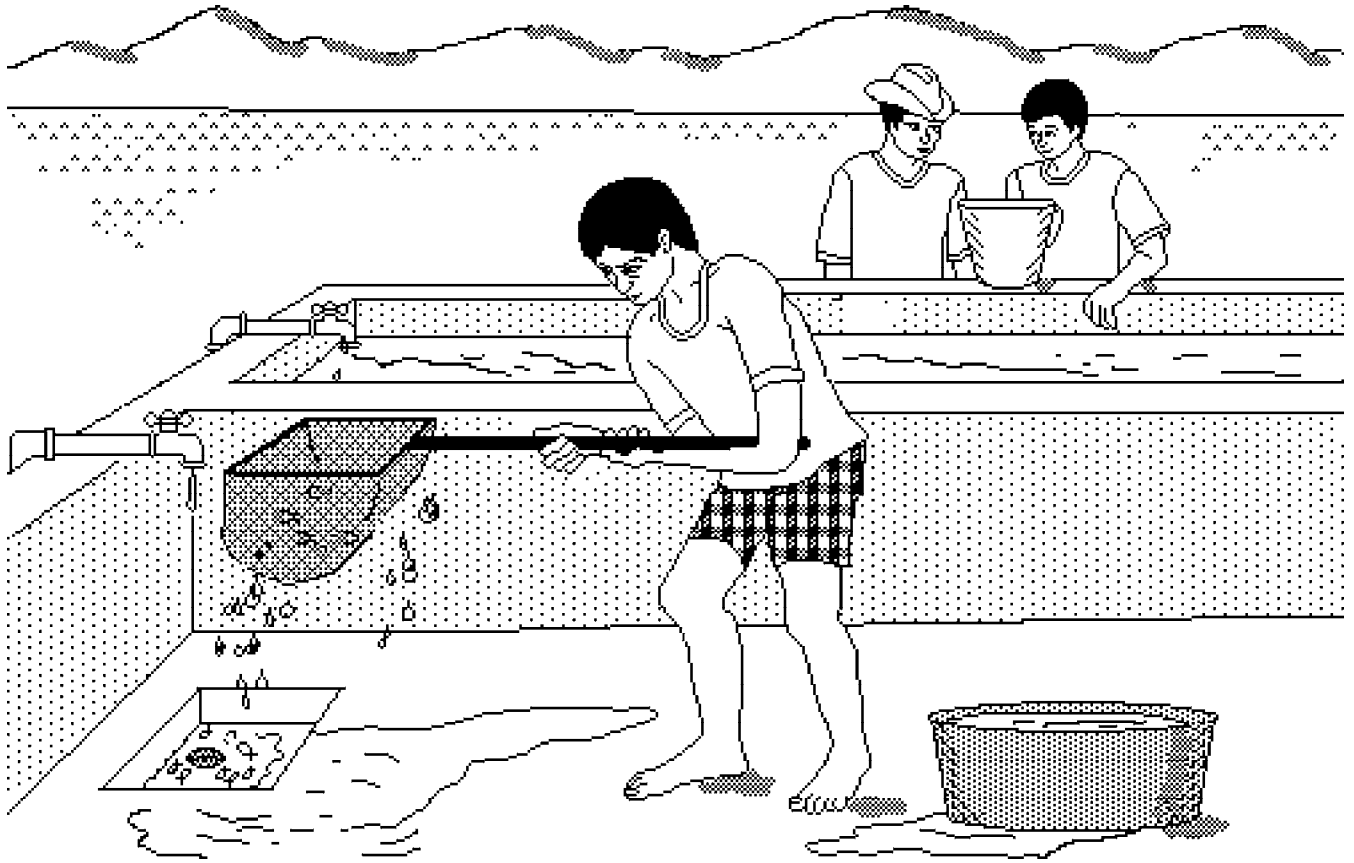


Figure 4: Removing fry from sump in floor of tank.

5. After 3 weeks of primary nursing, fry weigh about 0.25 g and are about 2 to 3 cm long. At this small size, survival in fattening ponds may be highly variable, so secondary nursing to 5 to 10 g is often practical. Stocking density in secondary nursery tanks is often 100 fry per m<sup>2</sup> plus 20% for expected mortality. Fish are grown 3 to 4 additional weeks. If large fingerlings are required, the stocking density should be reduced. In general, if the stocking density is cut in half, the final fingerling weight will double. Give fry a finely ground feed at the following rates:

1st week - feed at 10% of the total body weight divided into at least 2 daily feedings.

2nd week - feed at 7% of the total body weight divided into at least 2 daily feedings.

3rd week - feed at 5% of the total body weight divided into at least 2 daily feedings.

Daily water exchange of 10 to 20% or reduced feeding rates may be needed during the final days of rearing. Without water exchange, feeding more than 10 to 15 g of feed/m<sup>2</sup>/day may degrade water quality.

6. After secondary rearing, fingerlings should weigh 1 to 10 g and be 2.5 to 7.5 cm long. Fingerlings may be graded and stocked into cages, ponds or rice paddies for grow-out to market size or to a size suitable for manual selection of the males for monosex culture.

## How many tanks should be used?

The number and area of tanks needed for fry production depends on fingerling demand. Calculations can be made to determine the tank space required. A sample calculation follows:

### Assumptions:

1. A farmer needs 10,000 fingerlings per month.
2. Female *Oreochromis niloticus* weighing 200 to 300 g produce an average of 500 eggs per month (1.7 to 2.5 eggs per gram of female).
3. Brood fish are stocked at a rate of 4 per m<sup>2</sup> of tank surface area.
4. A stocking ratio of 1 male to 3 females is used.
5. Fry mortality is about 35% in the primary nursery with fry stocked at 600/m<sup>2</sup>.
6. Fry mortality is about 20% in the secondary nursery with fry stocked at 100/m<sup>2</sup>.

### Calculations:

#### 1. Secondary nursery:

##### a) Fish number:

$$\begin{array}{l} 10,000 \text{ fingerlings} \\ \text{of 1 to 5g size} \\ \text{needed/month} \end{array} + \begin{array}{l} 20\% \text{ expected mortality} \\ \text{of fry} \end{array} = \begin{array}{l} 12,000 \text{ fry needed for} \\ \text{secondary nursing} \end{array}$$

b) Area required: =  $12,000 \div 100 \text{ fry/m}^2 = 120 \text{ m}^2$

#### 2. Primary nursery:

##### a) Fish number:

assuming 35% average mortality the number of fry needed for stocking in primary nursery tanks =

12,000 fry needed + 35% for mortality = 16,200 recently hatched fry needed for primary nursery.

b) Area required: =  $16,200 \div 600 \text{ fry/m}^2 = 27 \text{ m}^2$ .

3. Fry production:

a) Brood females:

$16,200 \text{ fry} \div 500 \text{ fry/female} = \text{about } 33 \text{ females of } 200 \text{ to } 300 \text{ g.}$

or

$16,200 \text{ fry} \div 2 \text{ eggs/g of female} = 8,100 \text{ g of females}$  (= about 33 females of 250 g each or 81 females of 100 g each).

b) Brood males:

Number of males =  $33 \text{ females} \div 3 \text{ males/female} = 11 \text{ males}$

c) Area required: =  $(33 \text{ females} + 11 \text{ males}) \div 4 \text{ fish/m}^2 = 11 \text{ m}^2$ .

### **Advantages of the tank system**

1. Fry can be produced where space and water are limited.
2. Fry are easy to collect from tanks.

### **Disadvantages of the tank system**

1. Tanks are expensive to build or buy compared with an equivalent area of earthen ponds.
2. Disease, parasites, and poor water quality are more common problems in tanks than in earthen ponds.

### **Glossary of terms**

brood fish - sexually mature fish selected for reproduction.

chemical fertilizer - manufactured fertilizer containing nitrogen, phosphorous and potassium in varying proportions.

fingerling - a fish ranging in weight from 1 to 25 g or from 2.5 to 10 cm in total length.

fry - recently hatched fish weighing less than 1 g or measuring less than 2.5 cm in total length.

grading - sorting fish by size.

grow-out pond/facility - a pond or other facility used to grow aquatic animals to marketable size.

monosex culture - culture of all-male fish for market.

nursery pond/facility - a pond or other facility used to grow aquatic animals to a size suitable for stocking into a grow-out facility.

phytoplankton bloom - a dense growth of microscopic aquatic plants that causes water to become a green color.

school - a group or concentration of fish.

spawning - the act of depositing eggs and producing young.

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Alex Bocek, Editor  
International Center for Aquaculture and Aquatic Environments  
Swingle Hall  
Auburn University, Alabama, 36849-5419 USA

Suzanne Gray, Illustrator

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