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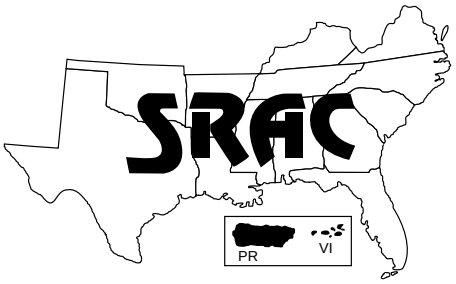

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Channel Catfish Broodfish and Hatchery Management

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This is one of several SRAC publications on specific topics related to hatchery economics, water quality, broodfish selection, fry pond preparation and compounds used for egg treatment. This publication is a reference and planning guide for channel catfish hatchery managers. In addition to reading each publication in the series, managers should visit hatcheries in their areas to view construction and management techniques.

Broodfish selection and care

Selecting good broodfish is essential to the success of any catfish hatchery operation. Following are broodfish sources in order of preference.

1. Fish from a registered or recognized improved line (SRAC Publication 1802)
2. Fish from an established hatchery
3. Fish of known, equal age selected from food fish ponds
4. Fish obtained from a commercial fisherman

Producers surveyed (USDA-APHIS 2004) reported that about 14 percent of broodfish are lost annually to fighting, disease and spawning stress. It will be necessary to supplement broodfish every 2 to 3 years. Be sure to select the best-growing fish from a group that are of equal age. If selected by size, fish will need to be sexed to obtain a proper male-to-female ratio of 1:1 or 2:3.

If all female broodfish spawned in a timely manner, it is estimated that as few as 600 pounds (272 kg) would be needed to produce 1 million fry (SRAC Publication 1802). However, data from USDA-NASS reports, combined with USDA-APHIS producer surveys, suggest that spawning success across the industry is 30 to 40 percent. Therefore, most farms maintain two to three times the minimum weight of broodfish to ensure proper numbers of eggs. Assuming a 70 percent hatch, a 70 percent survival to swim-up fry stage, a 50 percent spawning rate, and 3,000 eggs per pound (6,615 per kg) of female, a hatchery should maintain 1,350 to 2,000 pounds (612 to 907 kg) of female broodfish to produce 1 million fry.

The total weight of broodfish in ponds (males and females) should not exceed 1,200 pounds per acre (1,344 kg / ha). Broodfish can be transported and sorted just before the anticipated spawning period if proper fish handling techniques are used. Broodfish should not be crowded or stressed.

Broodfish should be sorted and moved annually to evaluate their condition and numbers. Large numbers of broodfish can be quickly sexed and evaluated by placing a small, flatbottom boat between two empty grading nets in a suitable area adjacent to the pond levee (see SRAC publication 1802 for instructions on determining the sex of broodfish). A small number of fish are placed in the bottom of the boat using a loading net. Two workers seated opposite one another, with the fish between them, select fish, determine the sex, and place the fish into the two grading nets. Designate a net on one side for males and the opposite side for

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females. This is repeated until all fish are sexed or the grading nets need to be emptied.

Many growers retire broodfish at a given size or age, but this decision should be based on the spawning success of the group. Fish larger than 10 pounds (4.5 kg) may spawn well but produce fewer eggs per pound. If production declines and a cause is not evident, consider replacing broodfish groups with less than a 30 percent spawning success.

Brood pond preparation

Each spring, broodfish should be moved to ponds that will have excellent water quality. To this end, a new or rebuilt pond is best for broodfish. If the pond has been in use for more than 2 years it should be completely dried to ensure good levels of dissolved oxygen when refilled.

In brood ponds it is important to eliminate aquatic weeds because they can severely restrict spawning, feeding and fish movement. In commercial catfish ponds with hardness and alkalinity greater than 50 mg/L, applying nitrogen has produced the best results with only minimal addition of phosphorus required. As soon as the pond is filled, apply 20 pounds of nitrogen per acre (22.4 kg/ha), or 40 pounds per acre (44.8 kg/ha) as urea. Add a few grass carp per acre where state regulations allow. Additional nitrogen should be added at the rate of 2 to 3 pounds per acre (2.2 to 3.3 kg/ha) every other day until a dense green color develops in the water column. An alternate strategy is to apply 200 to 300 pounds per acre (224 to 336 kg/ha) of commercial catfish feed or cottonseed meal as soon as the pond is filled and feed 10 to 20 pounds per acre (11.2 to 22.4 kg/ha) daily until a bloom develops. To test the density of the bloom, extend your cupped hand into the water. If your hand is still visible when your elbow meets the water line, the bloom is not dense enough.

In regions where alkalinity is less than 50 mg/L, a high-phosphate fertilizer such as 13-30-0 can be applied at the rate of 2 to 4 pounds per acre (2.2 to 4.4 kg/ha) on alternate days for 8 to 14 days.

Dissolved oxygen in the brood pond should remain above 5 mg/L at all times for successful catfish spawning. Brood ponds where spawning fails or stops should be examined for water quality, weeds and disease. If no cause is evident, moving the broodfish to another pond is often the best solution. Double stocking a current brood pond that has or is spawning well is often successful. Handle broodfish with extra care when moving them during the spawning period.

Spawning containers

Channel catfish are "cavity spawners" and require a chamber into which they can deposit eggs. Eggs adhere to one another and form a large sponge-like mass or matrix when the spawning process is completed (Fig. 1). Spawning cavities can be fabricated from objects such as ammunition cans, aluminum milk cans, plastic buckets or barrels. The opening should be 5 to 7 inches (12.7 to 17.8 cm) in diameter so larger fish can enter. Container volume should be at least 10 gallons (38 L), with 15 to 20 gallons (57 to 76 L) being optimal.

If eggs are transferred from the spawning containers to the hatchery two to three times each week, a ratio of one container for every three to four female brooders is adequate. For ease of collection and best spawning success, containers should be placed in water 2 to 3 feet (61 to 91 cm) deep around the pond perimeter, and spaced 6 to 7 feet (2 m) apart. There is less spawning at depths below 3 feet (1 m) because of low dissolved oxygen in the morning at lower depths.

The spawning season lasts several weeks. At peak spawning times it is not likely that more than 20 percent of females will spawn during a 48-hour period.

Removing eggs to the hatchery

Eggs must arrive at the hatchery in excellent condition. Containers such as coolers, mesh-lined fish baskets, and metal or plastic tubs can be used to transport eggs to the hatchery (Fig. 2). Placing a slightly inflated tire tube around the upper edge of the container will keep it

Figure 1. Channel catfish egg mass.

Figure 2. Collecting egg masses using a cooler with a tire tube float.

floating upright as it is towed around the pond. Dissolved oxygen in the container should remain near 5 mg/L and water temperature should be near that of the spawning pond until eggs arrive at the hatchery. Tubs or coolers should be partially drained and fresh pond water added at regular intervals during collection to maintain the proper level of dissolved oxygen. Never leave eggs unattended in strong sunlight or where temperature may climb rapidly. Remember that eggs can be killed or damaged by poor water quality, but may appear normal for 48 hours or longer.

To transport eggs to the hatchery, place them in a fry transport tank supplied with oxygen bubbled from airstones. If the water temperature in the transport container is more than 5 to 7 °F (2 to 3 °C) different from the hatchery water source, eggs should be water tempered for 15 to 20 minutes.

Upon arrival at the hatchery, treat the eggs with an iodine-based disinfectant. While dip treatments may save on chemical costs, it is better to put the eggs into hatching baskets at the proper rate and then make a trough treatment. Dip treatments must be well monitored and the eggs moved without delay to avoid over-treatment. Eggs are easily damaged if workers become distracted during a dip treatment and leave eggs in the treatment too long. Remember that dissolved oxygen is critical at all points, including during the disinfecting process. Using an airstone during this process can help relieve stress on eggs.

Hatchery water and troughs

Both well and surface water are used successfully in catfish hatcheries. The important water parameters are reviewed in SRAC Publication 461. If the hatchery uses groundwater, it should be degassed before entering the hatchery (SRAC Publication 191). With surface waters, degassing is not necessary. However, water should be filtered through rapid sand filters similar to those used for swimming pools. Sand filtration removes sediment that adheres to eggs and screens out insects. Sand filters should be backwashed regularly to avoid low water flows to troughs. Backwash filters at least twice a day when the hatchery is in full use.

The suggested water volume for a hatchery is 2 to 3 gallons (7.6 to 11.4 L) per minute per 100 gallons (380 L) of water volume in the hatchery. The calcium concentration in the water during the first 24 hours of egg development is critical to successful egg hatch (Small et al. 2004). If calcium hardness in the source water is less than 10 mg/L, add calcium chloride continuously using a peristaltic pump or a drip system. Either method should create a calcium concentration of 25 to 50 mg/L. Granular calcium chloride is approximately 77 percent calcium by weight. As a liquid, the calcium is 38 percent of the calcium chloride solution weight. Be sure to check the operation of the pump or drip system and measure the hardness of the incoming water at least once a day or whenever large numbers of troughs are brought on or off line.

A standard hatching trough is 8 feet long, 20 inches wide, and 10 inches deep (2.4 x 0.51 x 0.25 m), with 8 inches (20.3 cm) of water depth. It holds 100 gallons (380 L) of water. A trough of this volume will adequately hatch 20 to 25 pounds (9 to 11.3 kg) of eggs. Troughs are usually mounted on wooden or metal frames at a height of 30 inches (76 cm). Six to eight baskets made of ¼-inch (6.3-mm) mesh-coated wire, 3 to 4 inches (7.6 to 10.1 cm) deep and 7 to 9 inches (17.8 to 22.9 cm) wide, are placed in the troughs. Hatching trough water is circulated with paddles or airstones (Fig. 3). Paddles are usually 2 to 3 inches (5 to 7.6 cm) wide and 6 to 7 inches (15.2 to 17.8 cm) long, and rotate at 20 to 25 rpm. Paddles made from high-density polyethylene plastic (Fig. 4) are recommended for safety because they will slip on the drive shaft when strong resistance is met. Airstones, an alternative to paddles, are effective when placed down the centerline of the hatching trough with egg masses on each side of the bubble stream. If airstones are used, you can prevent fungal and bacterial problems by

Figure 3. Hatching trough with metal paddles.

Figure 4. High-density polyethylene plastic hatching paddle.

making certain eggs are not stocked at too great a density.

Disinfect troughs between batches with household bleach (5.25%). Mix 1 cup (250 ml) of bleach with 1 gallon (3.8 L) of water. Add a little liquid dish soap to the solution if desired. Use rubber gloves and proper ventilation when cleaning troughs. Do not let this solution come in contact with eggs or fry.

Estimating trough requirements

A single hatching trough will usually handle four to five weekly rotations of eggs, for an output of 200,000 eggs per week. Therefore, a single trough can usually yield 800,000 yolk-sac fry per season. After yolk-sac fry are transferred to rearing troughs or tanks, remove egg shells and dead fry from hatching troughs with a small mesh net or siphon hose.

Newly hatched yolk-sac fry can be transferred by siphoning them into a bucket using a ½- inch-diameter (1.3-cm) clear plastic tube. Newly hatched yolk-sac fry average 1,200 to 1,500 per fluid ounce (40 to 50/ml) and are placed in rearing troughs at the rate of approximately 150,000 per 100 gallons (380 L) of water. The rearing troughs are usually equipped with an agitator or three or four 8-inch (20.3-cm) airstones for aeration and water movement. Airstones should be slightly elevated from the tank bottom by placing rubber or plastic bands around each end. This prevents yolk-sac fry from being pinched under the stones. A suggested hatchery layout diagram is shown in Figure 7. A hatchery with 40 to 50 troughs can produce 20 to 30 million fry per season.

Egg hatching and treatments

Viable eggs are transparent, starting as a pale yellow and becoming darker yellow and finally orange-red. Dead eggs are opaque and usually enlarged. Water temperature in hatching troughs should be 78 to 82 °F (25 to 28 °C) (Table 1). Many hatchery managers believe they have the best success at 77 to 79 °F (25 to 27 °C). Depending on the stage at which eggs enter the hatchery, 5 to 6 days are usually required for hatching.

Hatching eggs will feel slippery; otherwise, masses should have a wet latex or rubber texture. External bacterial infections make eggs feel slippery to the touch. Eggs with "hairy patches" that appear white or brownish are infected with fungus. Small areas of fungus can be removed by hand, but keeping dead eggs clean with routine anti-fungal treatments is recommended. Catfish eggs can be treated with compounds such as hydrogen peroxide, iodine, formaldehyde, copper sulfate and common salt (see Table 2 and other SRAC publications).

Egg masses should not lie on top of each other in the hatching basket. Overcrowding causes problems that cannot be solved with egg treatments. Cloudy or bad-smelling water indicates severe egg degra-

Table 1. Egg development at 78 to 80 °F (25 to 28 °C).

Day	Egg appearance
1	Eggs pale, nearly white
2	Eggs dark yellow
3	Bloody streak appears
4	Embryo more golden with shape
5	Eyes visible—embryo moves frequently
6	Embryo complete—hatching
7	Yolk-sac fry

Table 2. Egg treatments.

All treatments are toxic to yolk-sac fry and should be discontinued as eggs become well eyed to eliminate the chance of killing eggs that may be hatching.

Compound	Method	Rate (for 100-gal. trough)
Hydrogen peroxide (35%)	Trough - 3 GPM flow*	110 ml (1-2 times per day)
Povidone iodine (1%)	Trough - 3 GPM flow*	50 ml (1-2 times per day)
Formalin (37% formaldehyde)	Trough - 3 GPM flow*	50 ml (1-2 times per day)
Copper sulfate crystal	Trough - 3 GPM flow*	10 g (dissolve in 5 gals. water, pour across trough 1-2 times per day)
Salt (NaCl)	Dip	1 lb. (dissolve in 5 gals. water, dip for 5 min. once a day as needed)

*Water is not stopped for treatment but runs continuously.

dation and high bacterial counts in egg troughs.

Yolk-sac fry

At hatching, the fry with attached yolk sacs will be orange-yellow with a black eye spot clearly visible (Fig. 5). At this stage, healthy fry will group tightly together near tank edges or in other areas with low current. Single fry or fry that appear whitish are frequently not viable. It is not uncommon to have a few fry (50 to 100) in each tank with this appearance. If more than 2 to 3 percent of fry are in this condition, problems with egg quality and water quality should be examined with the help of the state or regional aquaculture specialist.

Hatchery feeds

High quality fry feeds (#00 size), usually 48 to 50% protein, can be purchased in 50-pound bags. Catfish, trout and salmon starter feeds yield good fry growth in the first days post swim-up. In most cases one bag is sufficient for each 1 million fry. Live artemia and dried krill have also been fed to swim-up fry in hatcheries. These feeds are very expensive and are recommended only as supplements to a full nutrient diet, as in prepared starter feeds. Until fry have turned dark and begun to rise to the top of the trough, no feeds are necessary, as the yolk sac has not been fully consumed. Depending on individual hatchery needs and equipment, most hatcheries keep fry 2 to 4 days post swim-up (Fig. 6) before stocking them into prepared ponds. Fry have been stocked at swim-up and even as yolk-sac fry with good success, but most managers prefer to stock larger fry that have been fed for 2 to 4 days.

Store bagged hatchery feed on pallets in a dry area. Open bags of feed should be kept in plastic garbage cans with lids to prevent moisture from getting to the feed and causing mold growth.

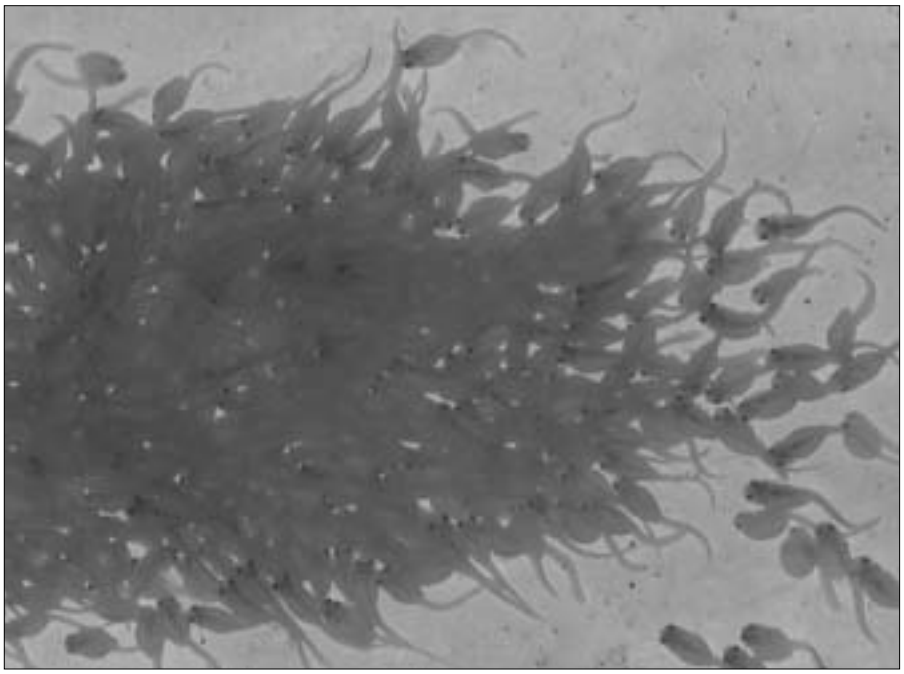

Figure 5. Yolk-sac fry at hatching.

Fry losses

Most fry losses are the result of poor handling in the egg stage, gas saturation in well water, or channel catfish virus (CCV). Consult your state or regional aquaculture specialist if your swim-up or yolk-sac fry losses are more than 2 to 3 percent of the total hatched in a given day.

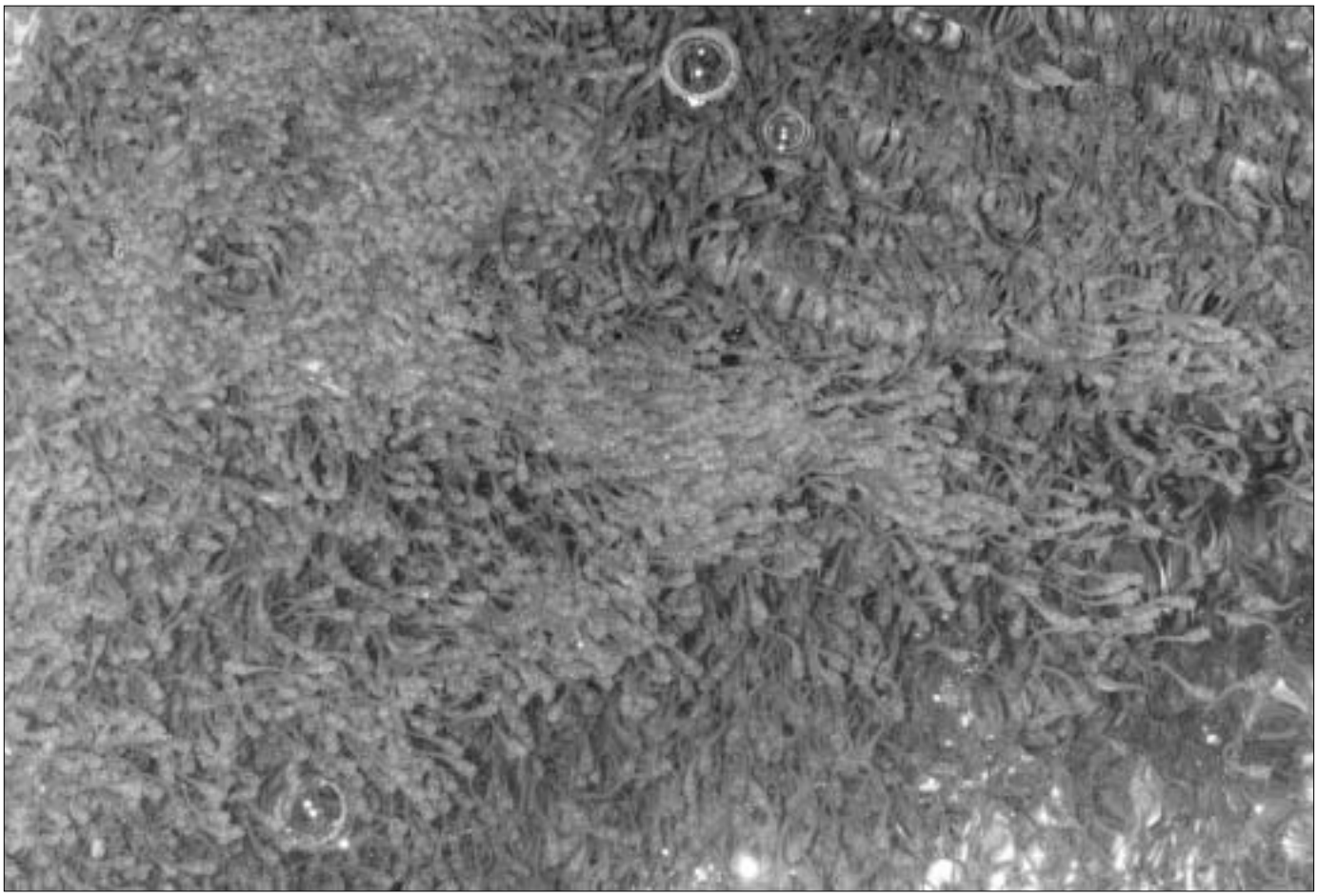

Figure 6. Swim-up fry 5 to 6 days post hatch.

Fry enumeration

Fry stocked or sold from the hatchery should be enumerated by weight or volume. Scales capable of weighing 50 to 200 fry (0.1-g accuracy) or small volumetric cylinders (10 ml with 0.1-ml graduations) are best for estimating fry counts. Counting a total of 150 to 200 fry per trough and finding their weight or volume displacement is sufficient for most purposes. Larger platform scales accurate to 0.1 pound or 0.05 kg, or graduated beakers with 100-ml graduations, are required for final total fry estimates.

Fry transport tanks

Unless fry are to be transported more than 20 miles from the hatchery, a single-wall, uninsulated, metal tank equipped with airstones is sufficient. Fry transport tanks can be constructed or purchased. Most commercial tanks are pulled behind a truck as a small trailer. These tanks usually hold 200 to 300 gallons (760 to 1,140 L) of water and have a V-shaped bottom, which slopes to a 2-inch (5-cm) drain equipped with a valve or gate and an attachment for a length of hose to reach the pond. Oxygen is released through airstones lying on the tank bottom. Bottled oxygen is preferred for transport because agitators operate at the tank surface, some distance from the fry, and are easily clogged. Fry density in the transport tank should not exceed 0.5 pound per gallon (60 g/L). Vaccines can be added to the transport water. Follow label directions carefully and maintain proper dissolved oxygen concentrations during the vaccination process. Salt may also be used during fry transport to reduce stress and coagulation of fry from transfer and enumeration. A concentration of 500 mg/L of common salt can be added when the transport tank is completely filled and the fry are on board. Because salt is very corrosive to metal surfaces, rinse the transport tank with water after fry are stocked into the receiving pond.

Fry are usually off-loaded when water temperature in the receiving ponds is close to that of the hatchery. This may be mid-day in the early portion of the season and early morning on hotter days. Tempering fry for differences in water quality is always recom-

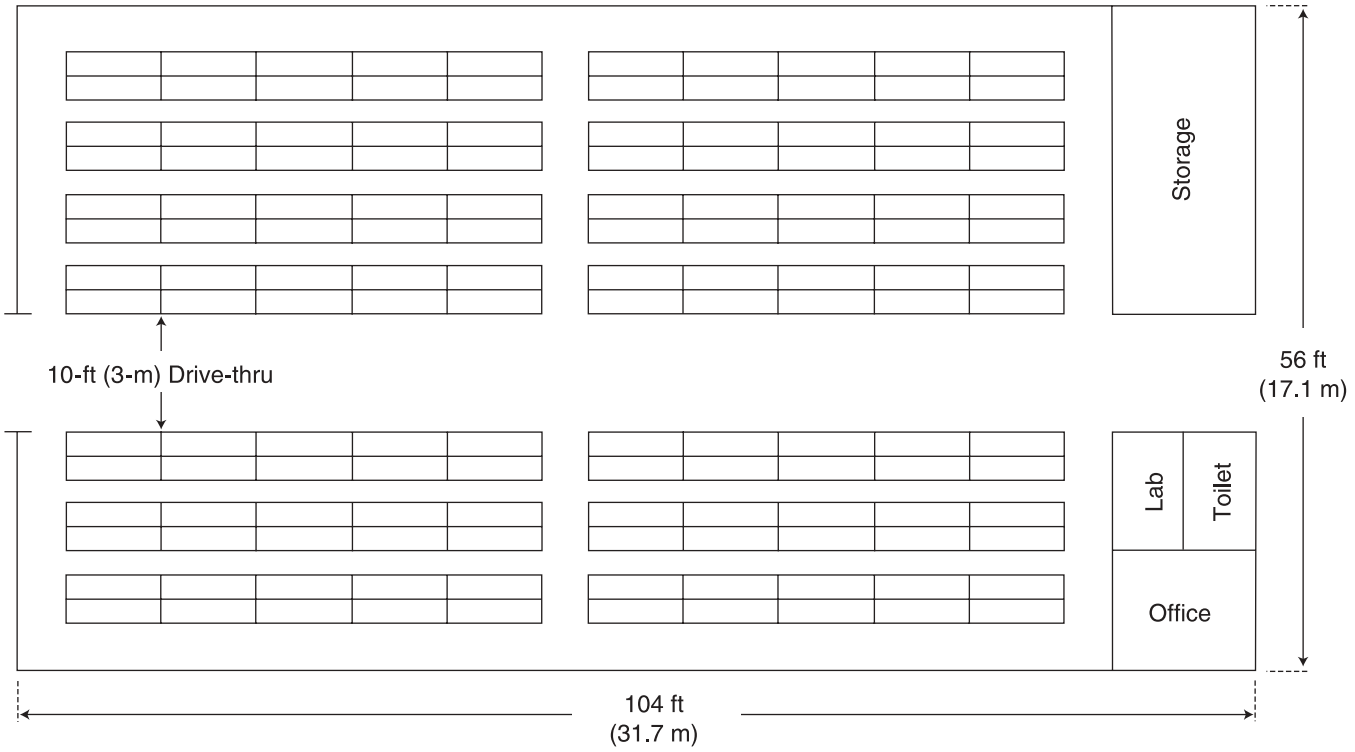

Figure 7. Layout for a medium-size hatchery.

mended and requires only 15 to 20 minutes. Buckets of pond water and/or a small pump discharging the receiving pond water can be used to rinse fry remaining in the corners and low areas of the transport tank.

General recommendations

Channel catfish hatcheries have many different layouts. They can be totally enclosed or largely open, depending on the site and the preferences of the operator. Closed buildings usually have large exhaust fans to create air flow. Open buildings may require shading with plastic tarps to keep out direct sunlight. There should be vehicle access throughout the building, if possible, to make loading and unloading easy (Fig. 7). Most hatcheries are metal frame, metal wall buildings on concrete slabs. Plumbing can be placed in the slab, hung from ceiling supports, or attached to the trough stands. Main water lines should be 2-inch (5-cm) piping with ¾-inch (1.9-cm) pipe leading to the individual troughs. Most often the terminal outlet is a hose-bib releasing water 2 to 3 inches (5 to 7.6 cm) above the trough water surface. Drains are usually 1 ½-inch (3.8-cm) pipe standing up 8 to 10 inches (20.3 to 25.4 cm) in the trough end opposite the water inflow. Window screen is usually attached to this standpipe to keep hatched fry from escaping the trough. Most hatcheries are plumbed largely with PVC pipe and galvanized metal pipe.

Hatcheries are labor-intensive operations that require a great deal of attention during the 2- to 3-month hatching season. Most operations require two or three seasonal employees in addition to a manager and two or three full-time assistants. The size of the operation and the size of fingerlings to be grown affect the hatchery labor budget.

If electric power fails there can be a total loss of the hatchery inventory in less than 30 minutes. Stand-by generators run by propane or diesel are necessary insurance against power failure. Even generators wired to start automatically in the case of power loss may fail, so check systems weekly. Consider having a back-up alarm system that notifies personnel in case of power failure. All personnel should know how to start generators (if they are manually operated) and who to contact in an emergency. There should be enough stand-by power to operate all systems, including the pump or well.

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