Farm-Raised Channel Catfish[1]

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Species Account

Taxonomy and Distribution

Channel catfish (*Ictalurus punctatus*) belong to the family Ictaluridae, in the large catfish order Siluriformes. The order includes over two thousand species, and most of them inhabit the fresh waters of the tropics. In the United States, the family Ictaluridae is native to the water drainages east of the Rocky Mountains, and contains about forty-three recognized species. Other important commercial species in the family include the blue catfish (*I. furcatus*), white catfish *I. catus*), yellow bullhead (*I. natalis*), brown bullhead (*I. nebulosus*), black bullhead (*I.melas)*, and the flathead catfish (*Pylodictis olivaris*).

Culture

History

The channel catfish is the primary species of farm-raised fish in the United States. Leading commercial catfish producing states are Mississippi, Arkansas, Alabama, and Louisiana. The ancestry of channel catfish farm-stocks is still unknown, but the majority of them are believed to have originated from Oklahoma stocks around 1949.

Life Cycle Characteristics

Channel catfish are reported to live up to forty years, attain approximately 1 m (40 in.) in total length and nearly 20 kg (44 lbs) in body weight. In the wild, however, fish over ten years of age, 53 cm (21 in.) in length, and 1.5 kg (3.3 lbs) in body size are unusual. Channel catfish can be sexually differentiated at about 6 months of age and normally breed for the first time in their second or third year of life. Thereafter, catfish will usually spawn every year throughout their life time. The spawning season of channel catfish is usually during the months of April through June; females start laying their eggs at water temperatures above 21°C (70°F). The eggs of channel catfish are large (2.4–3.0 mm or 0.1 inches in diameter), very adhesive, and usually laid in a large egg mass. Females have large variation in the number of eggs they produce, laying between 3,000 and 50,000 eggs, depending on the age and size of the fish; improved spawning success (number of eggs produced, larger eggs, and egg fertility) are observed in fish three to five years of age. Catfish have an elaborate breeding behavior and the male usually incubates the eggs. The period of incubation (hatching time) of catfish eggs depends on water temperature. Eggs hatch in four to ten days at temperatures between 21 and 27°C (70–81°F); at optimum spawning and incubation temperatures (25°–27°C), embryos hatch in 4 to 6 days. Young absorb their yolk sacs and begin swimming (swim-up stage) 3–4 days after hatching. After yolk absorption, young catfish actively feed on a variety of foodstuffs and readily accept artificially prepared diets.

Production Systems

Several production and management schemes are used to commercially produce channel catfish. Most of the farm-raised catfish are cultured in ponds constructed with levees. Average pond size is 7.1 water hectares (17.5 acres) on 8.1

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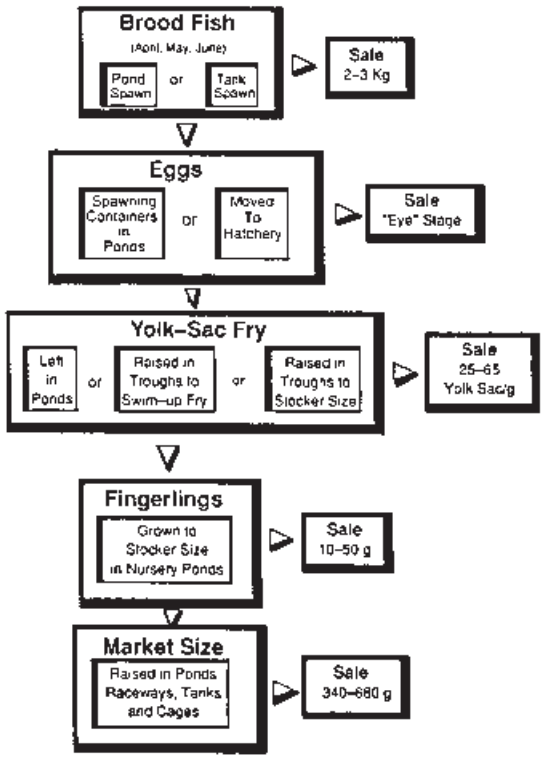
hectares (20 acres) of land. Although this large size pond is less expensive to construct, it is more difficult to manage; pond sizes between 5 and 10 acres are preferable. Catfish are also raised in watershed ponds, and in high-density culture systems that make use of tanks, raceways, and cages. Raising channel catfish mixed with other species of fish (polyculture) is also practiced. Figure 1 depicts a generalized description of a catfish farming system.



WATER REQUIREMENTS

Regardless of the production system employed, efficient production of channel catfish requires a dependable supply of large volumes of water. For example, in pond production at least 185–280 l/mm of water per hectare of pond surface (20–30 gpm/ acre) are essential. For intensive fish production in raceways, 5.7–7.6 m^3/min (about 235 ft^3/min) of water are necessary.

NUTRITION AND FEEDING

Channel catfish are efficient food converters and will gain between 0.45 and 0.67 g of body weight per gram of food consumed (e.g 1.5–2.2 lbs of feed/1lb of fish). Growth of channel catfish to fingerling and edible size is influenced by a variety of factors. Water temperature, quality of the diet, feeding rate, age of fish, and stocking density noticeably affect the growth rate of the fish. Catfish require a well-balanced diet high in protein and energy. Dietary requirements, however, are based on differences in age, size, water temperature, natural food availability in the pond, daily feed allowance, and stocking density of fish. Recommended dietary levels of crude protein vary from 25% to 36%, based primarily on quality of the dietary protein and amount of non-protein energy in the feed; starter diets for young fry should contain 36% to 40% crude protein. Supplemental energy in catfish diets is provided by high quality lipids (fats) at levels between 3% to 16% of the total diet. From a practical view point, however, lipid levels in catfish feeds are kept below 6%. Catfish can utilize a wide variety of types and amounts of carbohydrates in their food, so their levels are usually formulated at the least cost of the diet. Vitamins and minerals are an essential dietary requirement for channel catfish. Because of the small amounts required and susceptibility to degradation, catfish feeds are supplemented with vitamin and mineral pre-mixes.

The daily feed ration for channel catfish is affected by a variety of factors. The amount of feed provided depends on water temperature, fish size, and water quality. Newly-hatched fry should be fed several times daily at 6–10% of fish weight. The daily feed ration for fingerling and broodfish catfish should be divided into two or more feedings per day. In general, fingerlings are fed between 2% and 5% of their body weight per day, and broodfish, 1% to 2% of their weight.

YIELDS AND STOCKING DENSITIES

Fish yields and stocking densities for channel catfish are extremely variable and vary according to system of production used, level of management, and size and number of fish desired at the end of the growing season. The average yield of a fed and aerated production pond is around 4,000 kilograms of catfish per hectare of water (3,500 lbs/acre/year); by multiple harvesting (when fish are periodically graded and harvested) yields of 5,000–6,000 kg/ha/ year (around 4900 lbs/acre/year) can be obtained. When raising catfish in floating cages, yields of 275 kg of fish per cubic meter (17 lbs/ft^3) have been recorded.

Young fry are stocked primarily depending on the size and quantity of fingerlings desired at harvest; stocking densities from 20,000 to 70,000 fry per hectare (average 18,211 fry/acre) are common. In final grow out ponds, fingerling (10–50 g) stocking rates average around 8,500–10,000 fish per hectare (3,743 fingerlings/acre). In multiple harvest production systems, up to 24,000 fish per hectare (9,713 fish/acre) are reported. In net enclosures, stocking densities for 15–20 cm (6–8 in.) long catfish fingerlings range from 212 to 424 fish per cubic meter (6–12 fish/ft^3) of cage. Net pens are usually arranged in open patterns to allow sufficient water circulation through them. When suspended in ponds, total fish stocking densities inside the cages cannot

exceed those numbers which would be achieved by growing the fish free-swimming in the pond.

The time required to raise channel catfish to market size is primarily dependant on water temperature, age of fish, fish density, quality of diet and level of feeding. Estimated time to raise channel catfish from egg to food-size fish is between 15 and 18 months. In northern Florida, 7 to 9 months are necessary to raise 10–20 cm (4–8 in.) long fingerlings to around 453 grams (1 lb).

Product Forms

Most cultured channel catfish sold for food are harvested at 340 to 680 grams (0.75–1.5 lbs) in body weight. The majority of the farm-raised catfish production is delivered live for processing at an annual average price between $1.35 and $1.65 per kilogram (61–75 per pound). Expected marketable fish yield is about 60–65% dressed (headed, gutted, and skinless) from live weight. The nutritive value of channel catfish is estimated at about 116-128 kcal, 15–18 g protein, and 0.7–11 g fat per 100 grams of raw meat (a 3.5 oz serving). About half of the farm-raised catfish is marketed frozen. New product forms include skinless fillets and breaded catfish. Also, a substantial demand for live catfish exists within certain ethnic groups. Commercial catfish growers often purchase "eyed" eggs, yolk-sac larvae, and stock-size fingerlings.

Production and Marketing Considerations

The channel catfish has a wide range of tolerance to environmental fluctuations, however, optimum growth and production efficiency are obtained within a narrow range of physical, chemical, and biological parameters. The following parameters are provided only as guidelines; and indicate expected life cycle attributes of channel catfish under production conditions, and water quality criteria for best growth and reproduction.

Life History Characteristics

BROOD STOCK

- average weight/fish: 1.5–4 kg
- stocking ratio for spawning: 4 females to 1 male
- pond spawning success: 50%–90%
- eggs/kg of fish: 6,000–8,000

HATCHERY SURVIVAL

- egg to hatch: 60%–95%
- yolk-sac to fry (1.9–2.1 cm): 60%–80%

POND SURVIVAL

- fry to fingerling (10–15 cm): 40%–85%
- fingerling to market: 75%–90%

Environmental Requirements

- Water temperature for
- Optimum growth: 28°C–30°C
- Optimum spawning and embryo development: 25°C–27°C
- Dissolved oxygen: > 4.0 mg/l.
- Gas (e.g. Nitrogen) supersaturation: < 115%
- Carbon dioxide: < 15 mg/l
- Hydrogen sulfide: < 1.0 mg/1
- Salinity: < 5 ppt
- pH: 6.5–9.0
- Total alkalinity: 50–100 mg/l
- Total hardness: 50–100 mg/l
- Total ammonia nitrogen (TAN): < 0.5–1 mg/1

Sources of Information and Selected References

Considerable information exists on different methods for raising channel catfish to market size. This information, however, is primarily in the form of University Extension publications. For example, the Alabama, Florida, and Mississippi Cooperative Extension Services have several very complete publications on the culture of channel catfish. Please contact your county extension agent before ensuing any kind of aquaculture venture, and for information on how to obtain Cooperative Extension publications. Listed below are several sources of information and essential book references for those seriously interested in pursuing channel catfish farming.

Alabama Publications. Department of Fisheries and Allied Aquacultures. Auburn University, Alabama 36849.

Catfish and Aquaculture News. PO Box 199, Ridgeland, Mississippi 39158.

Catfish Farmers of America. Aquaculture Association. 1100 Hwy. 82 East, Suite 202, Indiano]a, Mississippi 38751.

Catfish Production. National Agricultural Statistics Service. ERS/NASS, PO Box 1608, Rockville, Maryland 20850. Telephone: (800) 999-6779.

Fisheries and Aquatic Sciences Department. University of Florida, 7922 NW 718t St., Gainesville, Florida 32606. Telephone: (904) 392-9617.

Lee, J.S. 1973. Commercial Catfish Farming. Interstate Printers &Publishers. Danville: Illinois.

Mississippi Cooperative Extension Service, Box 5446, Mississippi State, Mississippi 39762.

National Aquaculture Information Center. National Agricultural Library, Room 304, 1030 Baltimore Blvd., Beltsville, Maryland 20705.

Seafood Business Magazine. Journal Publication, P.O. Box 908, Rockland, Maryland 04841.

Seafood Leader Magazine. Waterfront Press Co., 1115 NW 46th St., Seattle, Washington 98107.

Tucker, C.S. and E. Robinson. 1990. Channel catfish farming handbook. Van Nostrand Reinhold. Florence: Kentucky.

Tucker, C.S. 1985. Channel catfish culture. Developments in aquaculture and fisheries science 15. Elsevier. Amsterdam: The Netherlands.

Useful Unit Conversions

Temperature Relations

°F = (°C × 1.8) + 32

°C = (°F - 32) ÷ 1.8

Metric Conversions

meters (m) × 39.37 = inches (in.)

centimeters (cm) × 0.394 = inches (in.)

millimeters (mm) × 0.039 = inches (in.)

hectare (ha) × 2.471 = acres (A)

liters (l) × 0.264 = gallons (gal)

cubic meters (m^3) × 35.31 = cubic feet (ft^3)

gram (g) × 0.0022 = pounds (lb)

gram (g) × 0.0353 = ounces (oz)

kilogram (kg) × 2.205 = pounds (lb)

grams per liter × 1.0 = parts per thou.