DISCUSSION

The retardation in growth of the channel and blue catfish between the third to seventh year indicates that some fish management measures should be put into effect that would bring about faster growth during this period. In comparing the growth of fish with the channel and blue catfish of Lake Texoma, Sneed and Leonard (1956), Jenkins (1956), and Santee-Cooper Reservoir, Stevens (1959), Kentucky Reservoir blue and channel catfish drop behind the growth of catfish in the above reservoirs. Overpopulation of these species of fish may be one of the factors causing retardation. Consequently, fishing gear capable of catching the small fish in this age group should be introduced in the reservoir to see if this condition can be improved.

At present there is a recent influx of Asiatic clam *Corbicula sp.* Sinclair and Isom, 1961. Catfish of all sizes are feeding extensively on these clams which may influence their growth in the future.

ACKNOWLEDGMENTS

The writers wish to express appreciation for the assistance of John R. Latendresse and the Kentucky Lake Fish Company in collecting data on catfish.

LITERATURE CITED

Sneed, K. E. 1951. A method for calculating the growth of channel catfish *Ictalurus lacustris punctatus.* Trans. Am. Fish. Soc., 80:174-183.

Carlander, Kenneth D. 1943. Age, growth, sexual maturity, and population fluctuations of the yellow pike perch, *Stizostedion vitreum vitreum* (Mitchill), with reference to the commercial fisheries, Lake of the Woods, Minnesota. Trans. Am. Fish. Soc., 73:90-107.

Sneed, Kermit, and Edgar M. Leonard. 1956. Age and growth of the channel catfish, *Ictalurus punctatus,* in Lake Texoma. Okla. Acad. Sci., 37:73-78.

Jenkins, Robert M. 1956. Growth of blue catfish, *Ictalurus furcatus* in Lake Texoma. The Southwestern Naturalist, 1(4):166-173, Oct. 1956.

Sinclair, Ralph M., and Billy Gene Isom. 1961. A preliminary report on the Introduced Asiatic Clam, *Corbicula sp.* Tennessee Public Health Department.

TRANSPORTATION OF CHANNEL CATFISH FRY IN PLASTIC BAGS

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1962

ABSTRACT

Channel catfish fry, ranging in age from one day old to about two weeks old, are routinely transported in polyethylene plastic bags with an oxygen atmosphere between fish hatcheries in Arkansas. Approximately 10,000 fry are transported per 18" × 32" bag in 1½ gallons of well-oxygenated spring water of moderate hardness. These fish are transported by both airplanes and station wagons.

INTRODUCTION

Several years ago it became obvious that channel catfish, *Ictalurus punctatus,*[1] were more easily propagated at the Centerton State Fish Hatchery, Centerton, Arkansas, than at the Lake Hamilton State Fish Hatchery, Lake Hamilton (Hot Springs), Arkansas, or the Joe Hogan State Fish Hatchery, Lonoke,

1 Names of fish used are the accepted common and scientific names as listed in American Fisheries Society, Special Publication No. 2, 1960.

Arkansas (the other two fish hatcheries operated by the Arkansas Game and Fish Commission).

Attempts to transport surplus fry channel catfish from the Centerton Hatchery to the other hatcheries by conventional means (ten gallon cream cans, fifty gallon barrels and tanks) were unsatisfactory. Experience gained in transporting fry walleye, *Stizostedion vitreum vitreum,* in plastic bags as described by Martin (1958) led us to try the technique on channel catfish fry.

During the past three years, 2,300,000 fry channel catfish have been transported in plastic bags between the State hatcheries with excellent results (Table I).

TABLE I—FRY CHANNEL CATFISH TRANSPORTED IN PLASTIC BAGS BY THE STATE HATCHERIES

Year	*Number*
1959	None
1960	300,000
1961	900,000
1962	1,100,000
Total	2,300,00

Commercial fish farmers were quick to see the possibilities of this method of transportation and a small traffic in channel catfish fry has developed with the commercial hatchery receiving approximately one cent each for the fry channel catfish. The fish farmer can raise these fry to fingerling size for about an additional one and one-half cents each, bringing the total cost of the fingerlings (to the fish farmer) to approximately two and one-half cents each, where formerly the cost varied from about seven to ten cents each if purchased outright from a commercial hatchery.

TECHNIQUE

When the channel catfish have hatched in the spawning containers and are about one day old, they are taken to the fish house where they are placed in aluminum troughs having a continuous flow of well-exygenated spring water. At this time the pond water is about 80 degrees Fahrenheit, while the spring water is about 64 degrees Fahrenheit. About fifteen minutes are used to temper the fry from the 80° F. water to the 64° F. water. The fry are held in the thoughs until a load is accumulated (100,000—200,000). This may require several days to a week. Table II gives some chemical and physical properties of the spring water.

TABLE II—SOME PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE SPRING WATER, CENTERTON STATE FISH HATCHERY, CENTERTON, ARKANSAS*

Dissolved Oxygen	9.0 Parts per million
Free Carbon Dioxide	7.0 Parts per million
Phenolphthalein Alkalinity	None
Methyl Orange Alkalinity	80.0 Parts per million
p^h	7.4
Temperature	67° F.

* Analysis made September 7, 1962. In May and June the temperature will be a little cooler and the carbon dioxide content lower.

For transport, ten thousand (10,000) fry catfish are placed in each polyethylene plastic bag (dimensions 18″ × 32″ × .003″) containing 1½ gallons of well-oxygenated spring water. One-half pound of crushed ice is added, then all air is expelled and the bag inflated with pure oxygen. The bag is sealed by wrapping a heavy rubber band around the twisted neck of the bag, doubling the neck over and rewrapping it. Actually, we use two plastic bags, one inside the other. Each bag is sealed separately. This is a safety measure in case the inner bag develops a leak. The temperature of the water in the bag after the ice is added is about 59° F.

The filled plastic bags are placed in cardboard containers and are transported either in station wagons or airplanes (Figures 1a and 1b). Total length of time the fish are in the bags when transported by air is about two and one-half hours (usually about two hours) while being transported by station wagon, they have

remained in the bags almost eight hours (usually about six and one-half hours). No mortality has been experienced in the bags when spring water was used; however, once when pond water was used in the bags some mortality was experienced.

In transporting the fish over the Ozark mountains from Centerton, Arkansas, the airplane usually flew at an altitude of about 5,500 feet; however, at one time the pilot took the airplane to 7,500 feet (trying to avoid a thunderstorm) with no apparent ill effect to the channel catfish fry.

In transporting by station wagon, the stack of cardboard boxes containing the plastic bags is covered by old quilts or a heavy tarpaulin to further insulate them and prevent the direct rays of the sun from shining through the glass windows on the boxes.

Several methods of tempering the fry channel catfish from the plastic bags into the nursery ponds have been tried. Converse to the method recommended by Martin (*op. cit.*) we found that we could not open all the boxes at one time and lay the exposed bags containing the fry upon the water. The sun's rays, shining through the plastic, quickly warmed the contents, resulting in mortality of the fish. The boxes are left covered in the station wagon and only opened as fast as they can be untied, placed in the tubs and the tempering process began (Figure 1c). The most successful method we have found is to roil the pond water with the hand, thus bringing up the cooler water from underneath which is dipped into a wash tub. The bags are taken from the cardboard boxes, immediately united, and the tops rolled down (Figure 1d). Usually, two bags are set in each tub, where over a period of about fifteen minutes to one-half hour pond water is periodically splashed into the bags until the water temperature in the bags is equal to the water temperature in the tub. It is better if the tempering operation is performed in the shade instead of the bright sunshine.

By the time the fry catfish arrive at the nursery pond the temperature of the water in the bags is about 60—65° F. (by airplane) or 70—75° F. (by station wagon). The pond water will range from 80 to 85° F.

We feel that the plastic bag method of transporting channel catfish fry is almost fool proof. Mortality losses have been due to human error, mechanical failures or unsafe flying weather which necessitated undue handling (bagging and unbagging).

We have experienced some loss of fry by too quick tempering into exceptionally hot, shallow, putrid water. Such conditions are sometimes experienced when ponds are first being filled over recently fertilized bottoms or where already bloomed pond water is used for filling the nursery ponds. We have also lost fry from predaceous insects by not immediately oiling the ponds.

Once the fry have been tempered into the nursery ponds, the technique for propagation of channel catfish as outlined by Crawford (1957) is followed.

ACKNOWLEDGMENTS

I am especially grateful to Mr. Bruce Crawford, Manager, Centerton State Fish Hatchery, for developing the holding and packaging techniques and to Mr. Clinton Richards, Manager, Lake Hamilton State Fish Hatchery, and Mr. Lee Brady, Manager, Joe Hogan State Fish Hatchery, for developing the technique for tempering the fry from the plastic bags into the ponds. Special recognition is due Mr. David Donaldson, pilot and biologist, and the men at the Joe Hogan State Fish Hatchery for their zeal in making the long drives in the station wagons.

LITERATURE CITED

Crawford, Bruce. 1957. Propagation of Channel Catfish, *Ictalurus lacustris*, at State Fish Hatchery. Proc. 11th Annual Conf. Southeast. Assoc., Game and Fish Comm., pp. 132-141.

Martin, Mayo. 1958. Walleye Hatching, Rearing and Transporting Techniques as Practiced in Kentucky. Proc. 12th Annual Conf. Southeast. Assoc. Game and Fish Comm. pp. 78-91.