Transactions of the Illinois State Academy of Science
(1996), Volume 89, 1 and 2, pp. 105-111

Comparative Survival and Growth of Various Size Channel Catfish Stocked Into a Lake Containing Largemouth Bass

Michael Dudash and Roy C. Heidinger
Cooperative Fisheries Research Laboratory
and Department of Zoology
Southern Illinois University
Carbondale, Illinois 62901-6511

ABSTRACT

Channel catfish (*Ictalurs punctatus*) ranging in total length from 76 to 203 mm were divided into five size classes (76-102; 103-127; 128-152; 153-178; and 179-203 mm) and stocked into a 17 ha lake. Three hundred catfish in each size class were group marked with silver nitrate. The catfish were sampled fourteen months after stocking. Relative survival increased with the increase in size class. If the largest size class was scaled to 100 percent, relative survival from smallest to largest size class was 02, 04, 42, 78, and 100%, respectively.

INTRODUCTION

In the U.S. new or renovated impoundments are frequently stocked with channel catfish (*Ictalurus punctatus*), largemouth bass (*Micropterus salmoides*), and bluegill (*Lepomis macrochirus*) (Flickinger and Bulow 1993). In many of these impoundments there is little or no recruitment by the channel catfish and supplemental stocking of hatchery reared fish is required to maintain the fishery (Finnell and Jenkins 1954). The introduction of channel catfish into ponds and small lakes is widespread. At least 35 states have channel catfish stocking programs (Smith and Reeves 1986). Both biological and economic success of such a stocking is largely determined by the survival rate of the channel catfish.

In lakes with established fish populations, the stocking of small fingerling channel catfish results in low survival due primarily to predation by piscivorous fishes (Mestle 1983; Storck and Newman 1988). Higher densities of smaller fish are stocked to try to compensate for losses due to predation. However, this practice is usually ineffective because catch rates remain low. Stocking programs using 20 cm and larger channel catfish fingerlings can produce fisheries in bass-bluegill lakes (Adair 1981; Broach 1967; Santucci et al. 1994). Higher survival provides partial justification for stocking larger fish, however, the increase in survival of larger fingerlings may be of limited economic advantage if production costs are high.

In many small lakes, the largemouth bass is well recognized as the primary predator of the stocked channel catfish (Crance and McBay 1966; Dillon et al. 1971). Based on an aquarium and pond study without any other forage species present, Krummrich and Heidinger (1973) concluded that one must stock channel catfish of at least 178 to 203 mm to avoid loss to predation by a 0.9 kg largemouth bass. Spinelli et al. (1985) in another aquarium study found that predation of channel catfish by largemouth bass was reduced when other vulnerable prey were present. The objective of our study is to determine if it is economically more advantageous to stock small fingerlings at higher stocking densities or large fingerlings at lower stocking rates.

MATERIALS AND METHODS

Channel catfish ranging in total length from 76 to 203 mm were divided into five size classes: 76-102, 103-127, 128-152, 153-178, and 179-203 mm. In June, 300 channel catfish in each size group were marked with silver nitrate (Thomas 1975) and stocked into Campus Lake. Cost per fish within each size group was based on retail prices of local commercial producers. Campus Lake is a shallow (maximum depth 3 m) 17 ha impoundment located in Jackson County on the Southern Illinois University campus in Carbondale, Illinois. The spillway was screened with a 1.2 cm bar mesh metal screen during this experiment.

Each size group was distinctly marked. Only one fish was marked with each applicator. Fingerlings were marked, measured to the nearest millimeter and held in a raceway for twenty-four hours prior to stocking. Mortality was less than 1% and the dead fish were replaced. One hundred similarly marked channel catfish were held in a rearing pond to validate mark retention. Total stocking density was equivalent to 88 fish per hectare.

The fish community in campus lake is composed primarily of bluegill (*Lepomis macrochirus*), redear (*L. megalotis*), and largemouth bass. Channel catfish are present but natural recruitment is very low.

The largemouth bass population was evaluated in terms of numbers and length frequency. The Chapman modification of the Schnabel mark and recovery method was used to estimate the largemouth bass population (Ricker 1975). Largemouth bass were sampled by electrofishing with a three-phase, 220 volt AC, balanced electrode array, boat mounted unit. Largemouth bass 200 mm or larger in total length were measured to the nearest millimeter and marked with a small caudal (dorsal end) fin clip.

Proportional stock density (PSD) of the largemouth bass population was calculated using 200 mm as stock size and 300 mm as quality size (Anderson 1977). PSD is defined as the number of fish equal to or larger than quality size divided by the number of fish equal to or greater than stock size. Other parameters that could affect vulnerability such as turbidity and vegetative cover were also monitored. Turbidity was measured with a Secchi disc and percent vegetative cover was estimated visually.

Fourteen months after stocking the one-plus year old channel catfish were sampled using five panel experimental gill nets (12.7, 19.0, 25.4, 32.0, 38.0 mm bar mesh), trotlines, and electrofishing. All sampling devices were used throughout the lake. The trotlines used 1/0 hooks and were baited with worms, chicken liver, small crayfish, and small pieces of fish.

Statistical tests were performed with the SAS system computer programs (SAS Institute 1988). Regression analysis was used to correlate size of fish at stocking with the percentage of each size class recovered and with the size of the recovered fish. Fisher's exact test was used to test for significant differences between the size of fish stocked and the number recovered.

RESULTS AND DISCUSSION

Fourteen months after stocking 121 (8.1%) of the 1500 stocked channel catfish were recovered. Most (91%) were obtained from the trotlines. Assuming that trotlines do not select for different size channel catfish within the size range in this study, there was a positive correlation (r^2=0.9513; p=0.0046) between the size of fish at stocking and the percentage of each size class recovered. Fisher's exact test indicated no statistically significant difference at the alpha 0.05 level between the smallest two size classes and between the largest two size classes (Table 1). Channel catfish stocked between 103-203 mm showed a linear relationship between size of channel catfish stocked and their relative survival (Figure 1).

After 14 months in Campus Lake the mean final total length of the 76-102 mm size group was 251 mm whereas the mean final total length of the 179-203 mm size group was 398 mm (Table 2). Final size was positively correlated (r^2=0.9505; p=.0047) with initial size. Mean growth rates ranged from 11.6 to 15.7 mm per month.

The largemouth bass population in Campus Lake is characterized by a large number of small fish (Figure 2) yielding a relatively low PSD value of 17 percent. At the time the channel catfish were stocked we estimated that the lake contained 73 ±29 (95% CI) bass per hectare.

Throughout this study grass carp (*Ctenopharyngodon idella*) reduced aquatic vegetation to less than 1.0% surface area. Secchi disc readings ranged from 51 to 125 cm.

If the percent of stocked channel catfish recovered are rescaled so that the 179-203 size group is 100%, then the survival of the four smaller size groups relative to the largest size group can be calculated (Table 3). Thus for every 100 fish of the 179-203 mm size group that survives only 2 of the smallest (76-102 mm) and 42 of the 128-152 mm size group survive. When the cost of fingerlings range from 0.06 cent each for the small size group to 0.32 cents each for the largest size group the relative cost per 100 large size group equivalence ranges from $300 for the smallest fish to $32 for the largest fish (Table 3). In general relative cost decreased with an increase in size stocked. However, the largest change occurred between the 103-127 mm size group and the 128-152 mm size group (Table 3).

Stocking cost per channel catfish returned to creel is dependent upon the initial production cost of the fish and their relative survival. It cost more to produce a large fingerling for stocking than it does a small fingerling at least within the size range used in this study.

Within the ranges of sizes stocked in this study, relative survival also increased with the size of fish stocked. Based on the trend in number of fish recovered from each size class, under the environmental and predator conditions found in Campus Lake at the time of stocking, it would have been most economical to stock the largest size group (179-203 mm). Statistically, however, there was no difference in the recovery rate of the two largest size classes, therefore, it would have been most economical to stock the smaller 153-178 mm size class. Santucci et al. (1994) found that there is no difference in recovery rates between 200-mm and 250-mm channel catfish. When the economics of stocking is based on survival the cost to produce each size group is a very important consideration. Actual production cost depends upon many factors such as type of hatchery, food cost, personnel cost, production technique, etc. Based on the relative survival in this study, the cost of the smaller size groups as a percentage of the largest size group would have to be 0.02, 0.04, 0.42, and 0.78, respectively, in order to be as economical to stock as smaller sized fish.

This study has provided needed information on the survival and relative cost of stocking various sizes of channel catfish into an established largemouth bass-bluegill community. Studies on other lakes are needed before relative survival can be modeled with respect to the predator population and other variables that affect vulnerability to predation such as vegetation and turbidity.

LITERATURE CITED

Adair, B. 1981. Open-water creel survey at Lake Anita, 1979-1981 with emphasis on effectiveness of channel catfish maintenance stockings. Iowa Conservation Commission, Des Moines, Iowa.

Anderson, R.O. 1977. Management of small warm water impoundments. Fisheries1(6):5-7, 26-28.

Broach, D. 1967. Arkansas' catchable channel catfish, *Ictalurs punctatus*. (Rafinesque), program. Proceedings South Eastern Association Game and Fish Commissioners. 21:445-452.

Crance, J.H., and L.B. McBay. 1966. Results of tests with channel catfish in Alabama ponds. Prog. Fish-Cult. 28:193-200.

Dillon, O.W., W.W. Neely, V.E. Davison, and L.V. Compton. 1971. Warm water fishponds. Farmers Bulletin 22J7, U.S. Dept. of Agriculture, Washington, D.C.

Finnell, J.C., and R.M. Jenkins. 1954. Growth of channel catfish in Oklahoma waters: 1954 revision. Oklahoma Fish. Res. Lab. Rep. No. 41, Oklahoma City.

Flickinger, S.A., and F.J. Bulow. 1993. Small impoundments. Pages 469-492 in C.C. Kohler and W.A. Hubert, editors. Inland fisheries management in North America. American Fisheries Society, Bethesda, Maryland.

Krummrich, J.R., and R.C. Heidinger. 1973. Vulnerability of channel catfish to largemouth bass predation. Prog. Fish-Cult. 35:173-175.

Mestle, G.E. 1983. Survival of stocked channel catfish in small ponds. M.S. Thesis, Oklahoma State University, Stillwater. 69 pp.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Res. Bd. Can. Bull. 191:97-99.

Santucci, Jr. V.J., D.H. Wahl, and T.W. Storck. 1994. Growth, mortality, harvest and cost-effectiveness of stocked channel catfish in a small impoundment. North American Journal of Fish Management 14:781-789.

SAS Institute. 1988. SAS/STAT user's guide. SAS Institute, Cary, North Carolina. 1028 pp.

Smith, B.W., and W.C. Reeves. 1986. Stocking warmwater species to restore or enhance fisheries. Pages 17-29 in R.H. Stroud, editor. Fish culture in fisheries management. Fish. Culture Section and Fisheries Management Section of the American Fisheries Society, Bethesda, Maryland.

Spinelli, A.J., B.G. Whiteside, and D.G. Huffman. 1985. Aquarium studies on the evaluation of stocking various sizes of channel catfish with established largemouth bass. North American Journal of Fish Management 5:138-145.

Storck, T., and D. Newman. 1988. Effects of size at stocking on survival and harvest of channel catfish. North American Journal of Fish Management 8:98-101.

Thomas, A.E. 1975. Marking channel catfish with silver nitrate. Prog. Fish-Cult. 37(4):250-252.

Table 1. Number and total length of channel catfish stocked and number recaptured 14 months later.

Size Class (mm)	Number Stocked	Stocking Density (per ha)	Number [1] Recaptured	Percent Recovered
76-102	300	18	1[a]	0.3
103-127	300	18	2[a]	0.6
128-152	300	18	22	7.3
153-178	300	18	42[b]	14.0
179-203	300	18	54[b]	18.0
TOTAL	1500	88	121	

[1] / Numbers with similar superscripts are not statistically different at alpha =0.05.

Table 2. Growth of channel catfish fingerlings recaptured after 14 months in Campus Lake.

Size Class Stocked (mm)	Mean Initial Length (mm)	Mean Final Length (mm)	Growth Rate (mm/month)
76-102	89	251	11.6
103-127	115	286	12.2
128-152	140	353	14.8
153-178	165	385	15.7
179-203	191	398	14.8

Table 3. Relationship between cost survival and relative cost of channel catfish.

Size (mm)	Relative [a] Survival (%)	Relative [b] Number Needed	Unit Cost ($)	Relative Cost ($)
76-102	2	5000	0.06	300
103-127	4	2500	0.10	250
128-152	42	238	0.25	60
153-178	78	128	0.29	37
179-203	100	100	0.32	32

[a] Relative survivals among size groups have been rescaled so that the 179-203 mm size group equals 100 percent.

[b] Number required per 100 of the largest size group (179-203 mm) recovered.

Figure 1. Relationship between the size of channel catfish stocked and the relative frequency of recapture.

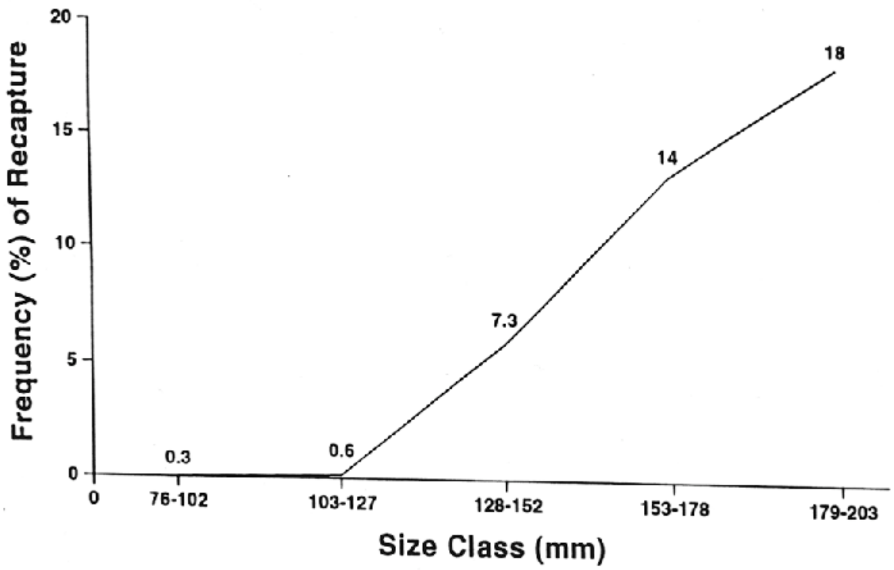

Figure 2. Length-frequency distribution for largemouth bass in Campus Lake.