Selection of Body Weight and Spawn Weight in Channel Catfish[1]

K. Bondari, *Department of Entomology and Fisheries, Coastal Plain Experiment Station, University of Georgia, Tifton, GA 31793*

Abstract: Selection responses were compared in 4 lines of channel catfish (*Ictalurus punctatus*) selected for: (1) large 40-week body weight (W+), (2) large spawn weight (S+), (3) small 40-week body weight and large spawn weight (W−S+), and (4) large 40-week body weight and small spawn weight (W+S−). Each line comprised 4 spawns hatched into 4 sibling sets. Ten randomly selected fish from each sibling set (40 fish per line) were included in the study and were grown in 2 segments of a recirculating raceway system. Results indicated that single-trait selection for 40-week body weight was most effective in increasing body weight and total length 9 and 28 months after selection was made. Joint selection for body weight and spawn weight (W+S−) was not as effective as selection for body weight alone (W+) on improving growth. Both lines were, however, more effective in growth improvement than S+ and W−S+ lines. Selection for increased spawn weight (S+ or W−S+) reduced subsequent growth severely. An index selection should be constructed to select for both growth and reproduction traits.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 37:348–351

Studies on systems of mating and selection methods of channel catfish have been summarized by Smitherman et al. (1978). Channel catfish have been selected for increased and decreased body weight (Bondari 1983) and for a combination of body weight and total length at various ages (Reagan et al. 1976). Response of channel catfish to joint selection of body weight and spawn weight, however, has not been studied. This study was designed to compare the response of channel catfish (*Ictalurus punctatus*) to: (1) selection for increased 40-week body weight, (2) selection for increased spawn weight, (3) joint selection of decreased 40-week body weight and increased

[1] Supported by State and Hatch funds allocated to the Georgia Agricultural Experiment Station.

spawn weight, and (4) joint selection of increased 40-week body weight and decreased spawn weight. This information should help breeders to design a breeding program to include both reproductive and growth traits of channel catfish.

Methods

Source and stock history of the broodfish used in the present study have been reported by Bondari (1983). Broodfish were randomly pair-mated in 182 × 152 cm chain-link-fenced spawning pens located in 0.1 ha earthen ponds. Spawns were weighed and artificially incubated in indoor tanks (30 cm width × 122 cm length × 51 cm height). Fish density was standardized and the siblings were reared together in indoor tanks for 40 weeks.

Spawn weight and the average 40-week body weight of the siblings hatched from each spawn were the bases for selection. Total number of spawns and sibling sets to select among was 53 from which 16 were selected (30%). Individual selection was practiced to form 4 lines: (1) selected upward for 40-week body weight (W^+), (2) selected upward for spawn weight (S^+), (3) selected downward for 40-week body weight and upward for spawn weight (W^-S^+), and (4) selected upward for 40-week body weight and downward for spawn weight (W^+S^-). Four sets of siblings were selected for each line and 10 fish (5 females and 5 males) were randomly selected from each sibling set to be included in the study. Summary information on number of selected sibling sets (families), number of fish per family, spawn weight, and 40-week body weight and total length is presented in Table 1. Total length was included to determine the correlated response to direct selection for body weight and spawn weight.

Selected fish from the 4 lines were weighed to the nearest g, measured for total length to the nearest mm, heat-branded, and placed in 2 segments of a recirculating raceway system described by Chesness et al. (1976). Each segment contained half of the fish from each line. The water inflow was aerated by a riser pipe as it entered the first segment and was reaerated by a vertical drop of 46 cm between the 2 segments. Each segment was 30.5 × 8.5 m with a concrete headwall in between and contained 125 m^3 of water. The fish were kept in the raceway for the 28-month duration of the experiment. The fish were fed a commercial trout ration (40% crude protein) twice per day. The amount of feed was determined as 3% body weight. Data were analyzed and means were compared using the Statistical Analysis System (SAS, 1979). Line, sex, and line × sex interaction were included in the model.

Results and Discussion

Average body weight ± S.D. of parental broodfish (5 years old) were 3.6 ± 0.7 kg for females and 4.0 ± 0.8 kg for males. Corresponding values

Table 1. Selection criteria and body weight and total length after selection for lines of channel catfish selected upward for 40-week body weight (W^+), selected upward for spawn weight (S^+), selected downward for 40-week body weight and upward for spawn weight (W^-S^+), and vice versa (W^+S^-).

Item	W^+	S^+	W^-S^+	W^+S^-
N families	4	4	4	4
N fish	40	40	40	40
Spawn weight (g)[a]	1,359C[b]	2,187A	1,752B	937D
40-week weight (g)	90A	72B	56C	86A
40-week length (mm)	218A	204B	186C	214A
	Selection differential			
Spawn weight (g)	+21	+849	+414	−401
40-week weight (g)	+22	+4	−12	+18
	Body weight (g)			
2 months after selection	188A	170B	140C	195A
9 months after selection	410A	252B	199C	270B
28 months after selection	1,260A	895C	906C	976B
	Total length (mm)			
2 months after selection	276A	263B	252C	275A
9 months after selection	352A	326B	299C	336B
28 months after selection	492A	454C	446C	469B

[a] Overall mean ± standard deviation for spawn weight, 40-week body weight, and 40-week total length were 1,338 ± 442.2, 68 ± 14.1, and 199 ± 14.9, respectively.
[b] Means within a row followed by different letters are significantly ($P < 0.05$) different.

for the total length were 65 ± 4 cm for females and 68 ± 4 cm for males. Average spawn weight was 1,342 g with hatchability of 51%. Spawn weight expressed as percentages of female body weight was 37.3%. Correlation coefficient between spawn weight and body weight of the female broodfish was significant (0.53).

Spawn weight and 40-week body weight diverged ($P < 0.05$) in the expected direction immediately after selection (Table 1). Selection differential values were negative for W^-S^+ line when selected for 40-week body weight and for W^+S^- line when selected for spawn weight. All other selection differential values were positive (Table 1). No significant association between spawn weight and 40-week body weight existed prior to selection ($r = 0.17$, $N = 51$ fish). The correlation coefficient was changed to −0.47 immediately after selection. Body weight and total length at 40 weeks of age were, however, strongly correlated ($r = 0.96$, $N = 52$ fish) and remained the same after selection.

Channel catfish from the W^+ line were heavier and longer than those from S^+ and W^-S^+ lines at 40 weeks of age and remained significantly heavier and longer throughout the 28-month experimental period (Table 1).

Fish from the W^+ and W^+S^- lines did not differ significantly at 40 weeks and 2 months after selection. As the experiment progressed, however, differences between the 2 lines were more apparent. The W^+ fish were heavier and longer than fish from all other lines after 9 months and at the end of the experiment (Table 1). The W^+S^- line ranked second and there was no significant difference between weight or length of the fish from S^+ and W^-S^+ which ranked third at the end of the experiment. No significant line × sex interaction was observed for body weight or total length.

The correlated responses in total length in each line followed a pattern similar to that observed for body weight and it could be assumed that the same genetic changes are responsible. Bondari (1980) reported a significant correlation coefficient of 0.88 between body weight and total length of 5-year old brood catfish and suggested that body weight alone be used as the basis for selection. The suggestion was based on the assumption that some of the same genes that control body weight in channel catfish also influence total length.

Single-trait selection for increased 40-week body weight (W^+ line) was most effective on increasing subsequent body weight and total length. Bondari (1983) reported that 1 generation of bidirectional selection increased the 40-week body weight and total length of the upwardly selected line by 21 and 9%, respectively. Body weight and total length of the downwardly selected line decreased by 20 and 4%, respectively. Joint selection of body weight and spawn weight in this study (W^+S^-) did not have as pronounced an effect on subsequent growth as did the single-trait selection for body weight (W^+). Selection for increased spawn weight (S^+ or W^-S^+ lines) reduced subsequent growth severely. These preliminary results suggest that selection for high or low spawn weight will reduce body weight. To improve both growth and reproductive traits, an index selection should be constructed.

Literature Cited

Bondari, K. 1980. Genetic experiments in channel catfish. Aquaculture Magazine 6(4):38–39.

———. 1983. Response to bidirectional selection for body weight in channel catfish. Aquaculture 33:73–81.

Chesness, J. L., K. S. Obenauf, and T. K. Hill. 1976. Chemical flocculation of catfish raceway effluent. Trans. Am. Soc. Agric. Eng. 19:192–194.

Reagan, R. E., G. B. Pardue, and E. J. Eisen. 1976. Predicting selection response for growth of channel catfish. J. Hered. 67:49–53.

SAS. 1979. SAS User's Guide. Statistical Analysis System Institute, Cary, N.C.

Smitherman, R. O., H. M. El-Ibiary, and R. E. Reagan, eds. 1978. Genetics and breeding of channel catfish. South. Coop. Ser. Bul. 223.