Spawning Season and Maturity of Blue Catfish in Kentucky Lake

R. Scott Hale,[1] *Hancock Biological Station, Murray State University, Murray, KY 42071*

Tom J. Timmons, *Hancock Biological Station, Murray State University, Murray, KY 42071*

Abstract: The spawning season and length at maturity were determined for female blue catfish in Kentucky Lake, Kentucky-Tennessee, where this species is commercially harvested. A gonosomatic index (GSI) was determined from 581 females of 3 length categories: 400–499 mm, 500–599 mm, ≥600 mm. The mean GSI for fish in the largest length category peaked at 3.72% during 1 May–15 May, when water temperature was 20.5° C, and rapidly dropped to 0.21% during 1 June–15 June. Spawning activity in 1986 peaked between 15 May and 15 June. Contributions to reproduction by fish <600 mm were clearly minimal. Population maturity of 241 females was described by the polynomial: $Y = 444.88 + 5.88X - 0.03X^2$ ($r^2 = 0.988$) where Y = fish length (mm) and X = percent mature. Females reached the 50% level of maturity at 661 mm and 100% were mature above 722 mm. Estimated ages at these lengths of maturity were ≥10 and ≥9 years (50% mature) and ≥11 and ≥10 years (100% mature) in Kentucky and Tennessee portions of the reservoir, respectively.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 42:128–132

The harvest of blue catfish (*Ictalurus furcatus*), channel catfish (*Ictalurus punctatus*), and flathead catfish (*Pylodictis olivaris*) is an important asset to the economies of western Kentucky and western Tennessee. Blue catfish are the most frequently harvested catfish species in baitlines (baited trotlines) and gill nets in Kentucky Lake (Timmons et al. 1986). Despite the importance of blue catfish to the commercial fishery, the spawning season and length at maturity are not well documented. Spawning activity is noted to occur during April and May in Louisiana and June in the Mississippi River near Keokuk, Iowa (Pflieger 1975), but is not documented in Kentucky Lake. Length at maturity is suggested to be 381 mm for fish in

[1]Present address: Kentucky Department of Fish and Wildlife Resources, No. 1 Game Farm Road, Frankfort, KY 40601.

the Mississippi River between Caruthersville, Missouri, and Dubuque, Iowa (Barnickel and Starrett 1951). In southwest Louisiana, Perry and Carver (1977) use a linear model to determine length at 50% maturity to be 481 mm for both males and females. The purpose of this investigation was to determine the spawning season and length at maturity of blue catfish in Kentucky Lake to better describe spawning stocks and the life history of this species.

Methods

Kentucky Lake, a 64,800-ha reservoir located in western Kentucky and western Tennessee, is the largest impoundment on the Tennessee River. Kentucky Lake is joined with Lake Barkley on the Cumberland River by a canal 4 km upstream from Kentucky Dam, allowing interchange of fish populations. The northern two-thirds of the impoundment, between Kentucky Dam at Tennessee River Mile (TRM) 22 and Interstate Highway 40 bridge at TRM 116, is characterized as lacustrine and usually at least 1.6 km across, while the southernmost one-third is more riverine.

Sexual development of female blue catfish was determined from a gonosomatic index (GSI) of fish from the lacustrine area of the reservoir. From November 1985 through June 1986 live fish brought into commercial fish markets were measured (total length), weighed ($\pm$ 1 g), and sex was determined. As a result of regurgitation and digestion during capture and holding time in market tanks, stomachs were usually empty, and stomach removal was not considered important for the accurate measurement of somatic weight. Ovaries were excised and weighed to the nearest 0.5 g (wet weight). The following equation was used to determine gonadal status: GSI = (ovary weight/(somatic weight-ovary weight)) $\times$ 100. Mean GSI values were determined for each of 3 length categories: 400–499 mm, 500–599 mm, and $\geq$600 mm. Use of 3 length categories reduced bias which results from the affects of fish size on gonadal weight (DeVlaming et al. 1982). During November through April, 1 mean GSI value was established monthly for each length category. Biweekly means were determined after April. A YSI Model 57 temperature/oxygen meter was used to monitor water temperature at a depth of 2 m below the surface in the river channel at TRM 45. Water temperature and mean GSI levels for each length category were plotted against the date. Rapidly descending GSI means indicated spawning had occurred.

Length at maturity was determined for females by macroscopic inspection of ovaries between 1 March and 14 May 1986. This time period was selected because it facilitated positive identification of gonadal conditions. Fish in the developing or further advanced stages as defined by Snyder (1983) were considered mature. Length at maturity was determined from a regression of the percent of the cumulative total of fish mature at each of 50 mm intervals above 399 mm on fish length. The 50% maturity level was established from this equation. Statistical analysis was conducted with PROC MEANS, GLM, and FREQ procedures of the Statistical Analysis Systems package (SAS 1982).

Results

A ratio of 1.00 male to 1.08 female was determined from a random sample of 1,099 fish stratified by length category (400–499 mm, 500–599 mm, ≥600 mm). In addition to these randomly sampled fish, 10 non-randomly sampled females were also collected but not included in data used to determine the sex ratio. The total sample was 528 males and 581 females. During November, developing ovaries were found in 2 fish from each of the larger length categories. Maximum GSI values from individual fish in these categories during November were 1.14% and 1.75% for 500–599 mm and ≥600 mm sizes, respectively, while mean GSI values for all 3 sizes were below 0.5%. Maximum GSI levels for individual fish during the study period in each category were 5.10% (400–499 mm), 10.22% (500–599 mm) and 14.36% (≥600 mm). A substantial increase in the mean GSI levels only occurred in the largest length category at 3.72% during 1 May–15 May, when water temperature was 20.5° C. A rapid decrease in the mean GSI to 2.11% during 16 May–31 May and 0.21% during 1 June–15 June indicated that spawning was completed (Fig. 1). The 1986 spawning season was determined to be 15 May to 15 June. Contributions to reproduction by fish <600 mm were clearly minimal based on mean GSI levels throughout the spawning season.

Length at 50% maturity was determined from 241 females subsampled between 1 March and 15 May 1986 from the total of 581 females used for GSI data. Fish examined ranged from 403 mm to 803 mm. The smallest mature female was 481 mm long. The following polynomial best described female length at maturity: $Y = 444.88 + 5.88X - 0.03X^2$ ($r^2 = 0.988$); where Y = fish length and X = percent mature. The 50% level of maturity was 661 mm as calculated from this equation. This relationship indicated that all females <445 mm were immature

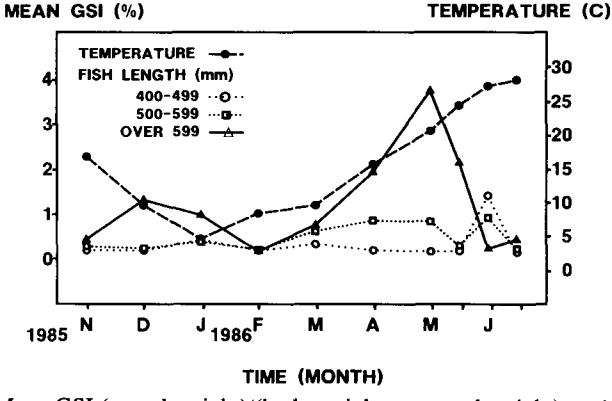

Figure 1. Mean GSI (gonad weight)/(body weight − gonad weight) × 100 for 581 female blue catfish of 3 length categories and water temperature on each sampling day in Kentucky Lake, November 1985–June 1986.

and >722 mm were mature. Ages at maturity were estimated based on current age at length models (Hale 1987) for the lacustrine areas of Kentucky Lake in both Kentucky and Tennessee. Based on these data, 50% of females were mature at ≥10 and ≥9 years of age in Kentucky and Tennessee, respectively, and 100% were mature in the next year at 723 mm in length.

Discussion

Present GSI results corresponded well with the sharp decrease in condition factors Freeze (1977) observed between May and June for Kentucky Lake blue catfish. These data also indicated that spawning occurred during a time range which agreed with previous information from geographic regions to the north and south of Kentucky Lake (Pflieger 1975). The geographic region influences the spawning season because thermal regime, day length, prey availability, and other factors affect gonad development (Nikolsky 1978).

Length at maturity information indicated that blue catfish in Kentucky Lake matured at larger sizes than those collected in the Mississippi River or Louisiana. Although Barnickel and Starrett (1951) consider their determination of length at maturity (381 mm) for Mississippi River fish somewhat arbitrary because few fish >400 mm were collected, extensive data collected by Perry and Carver (1977) indicates that blue catfish in Louisiana reach the 50% level of maturity at 180 mm less than female blue catfish in Kentucky Lake. Early maturation may be characteristic of some fishes in Louisiana. Data collected by Davis and Posey (1958) indicates that channel catfish mature 76 to 127 mm shorter in Louisiana than those in the upper Mississippi River. Differences in exploitation and growth rates may partially explain this. Variable exploitation of walleye stocks in the Western Basin of Lake Erie resulted in maturation at smaller sizes when stocks were heavily exploited, and maturation at larger sizes when stocks had recovered (Muth and Wolfert 1986). Similar results have also been observed for whitefish stocks in Canada (Healy 1975).

Length at maturity estimates may also be affected by models used to describe this relationship. In the present study use of a polynomial improved the r^2 value from 0.889 to 0.988. Without use of the polynomial, length at maturity would have been underestimated by 40 mm. Underestimation would negatively affect management due to selectivity of some commercial gears and a need to protect spawning stocks.

Catch data from a recent survey of the commercial fishery on Kentucky Lake indicates that few blue catfish >650 mm are commercially harvested and numbers of large, mature fish appear low (Timmons et al. 1986). These data, combined with the findings of this study, indicate that the bulk of the commercial harvest there consists of immature fish. This appears compatible with stable reproduction since declines in populations are virtually unknown throughout the history of the fishery. Successful reproduction of blue catfish in Kentucky Lake appears to be supported

by spawning stocks consisting of low numbers of the largest and oldest fish in the population.

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