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Individual and Relative Fecundity of Black Crappie (*Pomoxis nigromaculatus*) in Baldwin Cooling Pond

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ABSTRACT

Individual and relative fecundity were determined for eleven black crappie (*Pomoxis nigromaculatus*) collected in 1987 from Baldwin Cooling Pond, Randolph County, Illinois. Estimated number of mature ova ranged from 33,940 to 348,400 ova per individual in fish 225-322 mm in length. Mean value for individual fecundity was 143,762 ova per individual with mean relative fecundity of 411 ova per gram or 5000 ova per centimeter of total length. Individual fecundity was strongly correlated to both length and weight. Low recruitment was probably due to strong winds and to extreme and rapidly fluctuating water temperatures rather than fecundity.

INTRODUCTION

Crappie are an extremely popular sport fish in the United States, and were ranked first by Illinois anglers in terms of fishing preference (Baur 1988). As a result, management agencies spend considerable effort in the management of crappie populations. Often, crappie populations are characterized by slow growth and high recruitment which results in populations composed of small stunted fish (Ellison 1984).

In Illinois, electrical power generating cooling impoundments such as Baldwin, Heidecke, Powerton, La Salle, etc., provide a significant angling resource. However, in many of these impoundments, black crappie populations are often characterized by consistently low recruitment to the breeding population and by fast growth. Although condition of individuals is excellent, density is often too low to sustain an acceptable fishery.

In analyzing problems with recruitment, fecundity of broodstock is one parameter that should be considered (Cushing 1971; Schwartzman et al. 1977). We found only one

published study that determined fecundity of either black or white crappie (*P. annularis*) in a power cooling impoundment. Barwick (1981) evaluated fecundity of 59 female black crappie in Keowee Reservoir, South Carolina, a 7,435 ha reservoir operating under the influence of a 2580 MW nuclear electrical generating facility. Baldwin Lake is typical of many power cooling impoundments in that both white and black crappie exhibit problems with recruitment to the breeding population and with maintaining strong populations. Consistently low population densities and poor angler success at Baldwin Lake led to the investigation of fecundity as a potential factor for poor recruitment in this impoundment.

MATERIALS AND METHODS

Baldwin Cooling Pond is a 796-ha body of water, located in Randolph County, Illinois, with a mean depth of 3 meters and a maximum depth of 15.2 meters. The pond is rectangular with 90 percent of the 23.4 kilometer shoreline composed of rip-rapped levees. It provides cooling water for three base loaded 600-megawatt coal fired generating units.

Black crappie were collected in 1987-1988 for age and growth analysis. Black crappie were collected for fecundity analysis by weekly spring trapnetting from March 19 to May 7 in 1987. Water temperatures throughout the sampling period ranged from 15-30°C. Large trap nets were used, similar to those described by Willis et al. (1984). These trap nets consisted of a 122 cm x 178 cm frame, 1.2 cm bar mesh, and a 6 or 15.2 m lead. These nets were set throughout the pond but more often in suspected spring spawning areas. Individuals selected for fecundity analysis were classified as being in the ripening phase of gonad maturation (Snyder 1983). Ovaries were preserved in Gilson's fluid for approximately five months to allow the preservative to break down connective tissue and free the eggs from ovarian tissue. Samples were frequently agitated during the holding period to facilitate their separation. Enumeration of eggs was conducted in a manner similar to that described by Bagenal (1968) and Snyder (1983). Each sample was processed by carefully removing all remaining ovarian tissue from the eggs. All eggs were then washed repeatedly in tap water. When washings were clear of ovarian tissue, the eggs were placed in a graduated cylinder. To facilitate mixing of eggs for random sampling, a known volume of water was added. A large bore pipette was used to remove a subsample of known volume of eggs immediately after thorough mixing of the whole egg mass. Three subsamples were obtained and eggs were counted using a binocular dissecting microscope.

One-hundred eggs were randomly selected from one subsample and measured with an ocular micrometer to determine the percentage of maturing eggs in each sample. Black crappie spawn annually, in the spring or early summer; however, Barwick (1981) noted that not all ova in black crappie ovaries reach maturity each year. He observed smaller ova which remained in the ovaries in fish that were spent but considered only ova equal to or greater than 0.306 mm in diameter as being capable of reaching maturity. In order to help standardize the method of estimating fecundity, only ova equal to or larger than 0.306 mm were counted in this study. The mean egg counts from the three subsamples were converted to the total number of eggs present in the sample (individual fecundity). Individual fecundity was divided by the weight of the fish to give the value for relative

fecundity in number of eggs/gram and by total length of the fish to determine relative fecundity in number of eggs/cm.

RESULTS

In 1987-1987, 231 net nights of trapnetting yielded 139 black crappie for a mean catch per unit effort of only 0.6 fish per net night. Although numbers of fish were low, growth was excellent. Black crappie reached a harvestable total length limit of 229 mm between their second and third years of life. The mean total length for 36 United States central water populations by age three was 188 mm (Carlander 1977). The mean relative weight (Wr) value for all black crappie collected from Baldwin Lake was 97% of the standard length weight curve (Murphy et al. 1991).

Black crappie collected in the spring of 1987 were used in analysis of fecundity. Eleven female and seventeen males were collected in March-May 1987 in 56 net nights, resulting in a catch per unit effort of 0.5 fish per night. The estimated number of mature ova from the 225-332 mm crappie ranged from 33,940 to 348,400 ova per female. The mean value for individual fecundity was 143,762 (SD± 108,544) ova per female. Weight related relative fecundity estimates ranged from 157-643 ova per gram with a mean of 411 ova per gram (SD± 171). Total length related relative fecundity ranted from 1,383-11,025 ova per centimeter with a mean of 5,110 ova per centimeter (SD± 3077).

In Baldwin Cooling Pond, individual fecundity was significantly and almost equally correlated with both length and weight. The fecundity - weight relation from least squares regression analysis was best expressed by the following equation (Fig. 1):

log fecundity = 1.4327 + 1.4643 log weight with a calculated r^2 value of 0.7558

The fecundity - length relation also showed a strong correlation, and was best expressed by the following equation (Fig. 2):

log fecundity = -6.2192 + 4.6580 log length with a calculated r^2 value of 0.7449

DISCUSSION

Regardless of predictive capabilities, fecundity of black crappie collected in 1987 were clearly very high. Carlander (1977) lists eight studies (six in gray literature) in which individual fecundity of black crappie was determined. Values ranged from 11,000 to 188,000 ova per female for 73 to 680 g fish. Relative fecundity values were not given.

Occurrence of extremely high fecundity may be due to several factors. Studies by Scott (1961) on rainbow trout (*Oncorhynchus mykiss*) have documented that insufficient diet caused a reduction in egg number due to follicular atresia. Hester (1963) found that female guppies (*Lebistes reticulatus*) produced fewer offspring when adults were fed an insufficient diet. As previously discussed, the black crappie in Baldwin Cooling Pond exhibit excellent condition and growth. Conceivably, the abundance of food in the form of threadfin shad (*Dorosoma petenense*) and low density of adults may explain the high fecundity observed in Baldwin Cooling Pond.

Bagenal (1978) discusses the hypothesis that fecundity can be a population regulator, resulting in more ova being produced to cope with adverse environmental conditions. Baldwin Cooling Pond is subjected to strong winds and rapid fluctuations and extremes of temperature. Due to the open, almost treeless topography surrounding the lake, even low velocity winds can result in extreme wave action. Water temperatures fluctuate widely depending on intensity of power generation, and in 1987 ranged from 13°C on March 12 to 35°C on June 24. Summer temperatures are occasionally recorded which exceed 40°C when warm water from the power plant is discharged into the lake. Even though fecundity is relatively high it apparently has not offset other factors which negatively impact development of a strong sport fishery for this species in Baldwin Cooling Pond.

ACKNOWLEDGMENTS

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Figure 1. Individual fecundity of black crappie in Baldwin Cooling Pond as a Function of total weight.

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Figure 2. Individual fecundity of black crappie in Baldwin Cooling Pond as a Function of total length.

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