EVALUATION OF THREE SPAWNING TECHNIQUES FOR YELLOW PERCH

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ABSTRACT

Yellow perch *Perca flavescens* stocking requests have increased in South Dakota, necessitating increased hatchery production. This study compared the effect of three different spawning methods – hand (manual spawning), cage (naturally-deposited and fertilized in cages), net (naturally-deposited and fertilized in modified fyke nets) – on embryo survival to the eyed-egg stage. Egg survival was significantly different among each of the three techniques, with hand spawning yielding the highest median egg survival (69%), followed by cage (50%) and net (29%) spawning. Based on these results, we recommend hand spawning to maximize survival of yellow perch eggs. Cage spawning produced eggs with moderate survival making this a viable spawning method when low numbers of ripe females are available for hand spawning. Collecting eggs via net spawning should be done only if time, manpower, and incubation constraints do not exist.

Keywords

spawning, yellow perch, egg procurement

INTRODUCTION

Yellow perch *Perca flavescens* can be a highly targeted sportfish in South Dakota during both winter and summer months (Blackwell et al. 2007; Lucchesi 2010). High angler preference and inconsistent natural recruitment of yellow perch in many eastern South Dakota lakes have initiated efforts to increase their abundance through supplemental stocking efforts (Brown and St. Sauver 2002). Developing propagation techniques are necessary to consistently meet these stocking demands.

Yellow perch have a unique reproductive strategy in which females expel their eggs in a protective matrix (1.2 to 2.4 m long) upon submergent structure, such as vegetation, woody debris, or gravel (Carlander 1997). Following spawning, parental care is not provided by either gender. As the incubation interval progresses (multiple days later), the connective tissue of the matrix will deteriorate. Because yellow perch eggs are initially connected, multiple methods of procurement are available. For example, eggs can be collected by allowing broodstock to spawn naturally in impoundments (Jansen et al. 2009) or in net pens stocked with prespawn males and females (Hart et al. 2006). In other instances, adults can be spawned in tanks under appropriate water temperatures (Kayes and Calbert 1979). All of these strategies require male yellow perch to naturally fertilize the eggs. Hand spawning is an alternative strategy. Dabrowski et al. (1994) synchronized ovulation in perch through hormone injection. This has implications for collecting a large number of eggs from a captive broodstock during a short timeframe. These eggs could be manually stripped into a dry pan and then semen could be added directly from a male or by using semen that had been preserved (Ciereszko et al. 1993). Addition of water and stirring with a feather will result in fertilization within 30 seconds (Hart et al. 2006). Although there is documentation on how to collect yellow perch eggs using a variety of methods, no studies have compared egg survival among these techniques. Therefore, the objective of this study was to evaluate the effects of different spawning techniques on yellow perch egg survival to the eyed-stage of development.

METHODS

Yellow perch eggs were collected daily from April 21 through May 1, 2009 from Lake Madison (surface area = 1,070 ha), Lake County, South Dakota when water temperatures were between 8.8 and 16.1 ºC. A total of 30 modified-fyke nets (0.95- or 1.9-cm bar mesh) were used to collect adult yellow perch. Each net fished for an approximate 24-h period before being emptied and reset during morning hours. Eggs were collected using three techniques, and the sequence of egg collection was the same each day.

Net Spawning—Upon arriving at a modified-fyke net, we collected egg masses which had been deposited in the pocket of or on the outside of the modified-fyke net and placed them in buckets that contained lake water.

Cage Spawning—After the egg masses had been removed from the fyke net (net spawning), all yellow perch were also removed and the females were examined. Females that were determined to be unripe (green) and some males were transferred to holding cages (cage dimensions: 1.83 m high x 1.22 m wide x 1.22 m long) within Lake Madison. A total of eight cages were used. Male to female ratio in the cages varied from 2 to 3 males per 1 female. The overall density of yellow perch per cage was approximately150 fish/m^3. Egg masses that had been deposited were removed daily and then placed into buckets filled with lake water. Following egg collection from the cages, we examined all yellow perch from each cage, and perch that exhibited obvious signs of stress (e.g., abrasions) were released. Spent females were also released while green females were returned to that cage. No record was kept of the number of days green females were returned to the cages. New males and unripe females that had been collected from the overnight modified-fyke net sets were added daily to replace adult perch that had been released, but overall density and male to female ratio were maintained as previously described.

Hand Spawning—Females that were determined to be ripe both from the cages and from the modified fyke-nets were placed in separate tanks until hand stripping and fertilization using the dry method commenced. Thus, eggs were stripped from females that had been collected that day in nets and from females that had ripened over time in the cages. Individual females were stripped, and one egg mass was spread out in a pan. A minimum of 5 mL of semen was added from two males. Lake water was added, and the pan was gently agitated for approximately 2 min. The skein was rinsed and place in a bucket with lake water.

Methods in Common—Eggs were kept separated by technique, transferred into bags filled with lake water within 1-hr of being collected and then placed in insulated styrofoam boxes. The ratio of egg weight to volume of water in buckets or transport bags never exceeded 120 g/L. The boxes were transported and arrived at Blue Dog Hatchery (rural Waubay) within 5 h of being collected. This evaluation included eggs that were collected only between April 23 and 28, 2009, as April 23 was the first day eggs were collected by all three techniques and April 28 was the last day eggs were collected by all three techniques.

At the hatchery, the eggs were weighed to the nearest gram, placed into McDonald Jars and incubated separately by date and collection technique. Overall mean (± SD) egg weight (g) per jar was 975 (± 150) for hand spawn, 1,029 (± 203) for cage spawn, and 984 (± 168) for net spawn To estimate the number of eggs/g, all the eggs in four, 1-g subsamples were counted, and an average value of 234 eggs/g (SD = 52) was calculated, which was very similar to the estimate of 230 used during 2008 (Broughton et al. 2009). Therefore, 230 eggs/g was applied to the total known weight of eggs in each jar. The average number of eggs/g was multiplied by the weight (g) of the eggs in each jar to determine the total number. Water flows varied but were maintained at a minimum of 2.4 L/min for each jar. All eggs were subjected to a daily flow-through prophylactic treatment of formalin (1,667 mg/L for 15 m) to prevent egg mortality due to fungal infestation (e.g., *Saprolegnia* spp.). Following ten days of incubation in 9.4 °C filtered well water, there was a considerable difference in the color of eyed eggs (grey) compared to dead eggs (yellow). To estimate the percent of eyed eggs within a jar, we used a transparent grid wrapped around each McDonald Jar. The grid contained 12 squares with each square being 100-cm^2. The percent of eyed eggs (grey color) in each square was visually estimated to the nearest 10%. The percent survival for each jar was then determined by calculating an average from those 12 values.

Experimental Design and Statistics—A McDonald Jar was considered an experimental unit and the sample size (n) represents the number of jars containing one of the collection techniques. Replication was highest for cage (n = 51), moderate for net (n = 47) and lowest for hand spawning (n = 21). Plots of mean egg survival were examined daily to determine if techniques performed similarly over the egg collection interval. The pattern in egg survival was the same each day, so pooling data across days for each technique was considered appropriate. Percent egg survival among the three techniques was compared using a non-parametric Kruskal-Wallis test, as the assumption of homogeneity of variance was not satisfied (Levenes Test Stat = 4.78, P = 0.01). Games-Howell test for unequal variance was used to compare egg survival between techniques (post hoc pairwise comparisons). Statistical significance was set at $P < 0.05$. Egg survival values for each technique were depicted with box plots where first quartile, median, and third quartile values are presented. Whisker bars represent the 10th and 90th percentiles.

RESULTS AND DISCUSSION

Egg survival to the eyed stage was significantly different among (Kruskal-Wallis Test Stat = 67.458, df = 2, $P < 0.001$) and between collection techniques (all post hoc pairwise comparisons $P < 0.001$). Median egg survival was significantly highest for hand (69%), moderate for cage (50%), and lowest for net (29%) spawning (Figure 1). Hand spawning provided significantly higher survival to the eyed stage than cage and net spawning, presumably due to an increase in fertilization rates via manual fertilization. Hart et al. (2006) describes collecting yellow perch eggs through hand spawning and also through harvesting fertilized eggs from ponds. Harvesting eggs from the wild may result in eggs that are incompletely fertilized. They suggest hand spawned eggs provide higher and more consistent

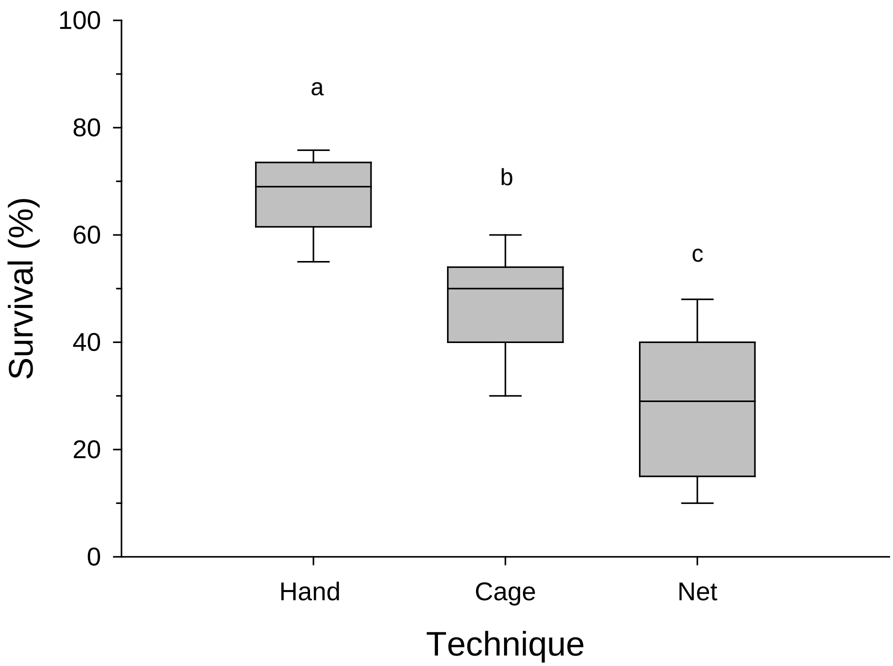

Figure 1. Box plots (first quartile, median, and third quartile values) of yellow perch egg survival to the eyed stage for hand, cage, and net spawning techniques on Lake Madison, South Dakota, during 2009. Whisker bars represent the 10th and 90th percentiles. Techniques with different letters are significantly different (P < 0.05).

fertilization rates. The results of this study support the recommendations of Hart et al. (2006). Eggs collected via cage spawning provided significantly greater survival than net spawning. The exact cause for this is unknown, but is likely a result of higher fertilization rates for eggs collected in the cage spawning technique.

In instances when incubation space is limited, emphasis should be placed on collecting eggs using hand spawning as this technique will yield more fry for a given number of eggs compared to the other two techniques. The number of eggs collected via hand spawning is going to be directly dependent on the number of ripe females that can be collected. Perhaps an additional number of hand spawned eggs could be collected by maintaining a yellow perch broodstock in a hatchery pond. This may serve as a consistent source of females to be hand spawned provided overwinter temperatures are suitable in the pond to allow for normal sexual maturation (Hokanson 1977).

Although the survival of the cage spawn eggs was lower than that of hand spawned eggs, the cage spawn technique produced reasonable egg survival. Thus, this technique may prove to be necessary when limited numbers of ripe females can be obtained for hand spawning. Future studies should attempt to manipulate male to female ratios and overall density of prespawn perch in the cages. Hart et al. (2006) suggest maintaining adult prespawn yellow perch at low densities in cages (< 10 perch /m^3). The density used in the cages of this study was over 10X greater than that suggested by Hart et al. (2006). Perhaps egg survival may be increased in cages that are stocked with different overall densities or increased numbers of male yellow perch. Eggs collected via net spawning yielded the lowest survival and should be given the least priority. However, if incubation space is available, this technique will produce a low number of fry relative to the number of eggs collected.

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