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Pond Culture of Hybrid Walleye Fingerlings

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Introduction

Natural hybridization between walleye and sauger has been documented, and hybrids have been artificially propagated (Nelson et al., 1965; Colby et al., 1979). Here, we will use the term hybrid walleye (otherwise known as "saugeye") to refer to the progeny of the cross between walleye female x sauger male, and the term reciprocal cross to refer to the cross between sauger female x walleye male. Our laboratory has produced both hybrids since 1986, and our first report was a comparison of survival, growth, and reproductive development of walleye, sauger, and their hybrids (Malison et al., 1990). In this study, and in subsequent work with hybrids, we have used fertilization, incubation, and culture practices similar to those employed for purebred walleye production.

Methods

Spawning, fertilization, and incubation

Initially, hybrids were the offspring of ripe walleye captured from Rock Lake, Jefferson County, WI, and ripe sauger captured from the Mississippi River (from northern Iowa and central Minnesota), the latter with the help of the Minnesota and Iowa Departments of Natural Resources, and the U.S. Fish and Wildlife Service. Following capture, the broodfish were transported to our aquaculture facility located at the Lake Mills State Fish Hatchery, Lake Mills, WI, and held indoors in 200-gal (750-L) circular tanks supplied with well water at 52°F (11°C). Ultimately, we produced and maintained captive, fertile broodstocks of walleye, sauger, and both hybrids, and evaluated various performance traits, as well as reproductive development and sexual expression.

To produce hybrid walleye, eggs were stripped from female walleye into a slightly dampened plastic bowl. Semen was collected from at least three male sauger, pooled, and added to the eggs. We have used stored semen with good success; semen &luted 1:4 with extender (Moore 1987) retains good motility for up to 14 d when stored in oxygen and under refrigeration (35–40°F [2–4°C]). In our storage protocol, a thin layer < 0.2 in [0.5 cm] in depth of extended semen is kept in a screw cap Nalgene® container and oxygenated every other day. For both walleye and sauger good sperm motility is characterized by an excited response of virtually 100% of the cells lasting for at least 15 s after activation with water. As the quality of the semen degrades, both the number of responding cells and the duration of their activity diminish. When using undiluted semen obtained from outside sources, we have found that motility, and therefore success at fertilization, decreases rapidly with age, even if such samples are stored under similar conditions as extended semen. In addition, traces of blood and other contaminants in the semen reduce the length of time that semen can be successfully stored.

Water (52°F [11°C]) is added to activate both the eggs and sperm, and the eggs are gently swirled in the bowl for 45 s to allow fertilization to be completed. A suspension of bentonite (a slurry made by mixing powdered bentonite and water to a creamy consistency) is added to prevent clumping, and the swirling is continued for an additional 2 min. The eggs are then rinsed repeatedly to remove excess semen and bentonite, and are allowed to water harden for 2 h. Water-hardened eggs are transferred into the traditional McDonald jars for incubation. On occasion we added eggs to jars prior to water-hardening, with no apparent reduction in hatching success. We incubate the eggs under a gradually increasing temperature regimen (+ 1°F [0.5°C] daily, from 52–59°F [11–15°C]), which results in an incubation period of approximately 11–13 d. Eggs are treated with formalin (1:1000 static bath for 15 min) once daily to inhibit fungal growth.

One difference noted during the fertilization and incubation of purebred and hybrid walleye and sauger is that the eggs obtained from sauger females are signifi-

cantly smaller than those from walleye. When measured by volumetric displacement, we calculated sauger eggs to be 208,000/qt (220,000/L), and walleye eggs 90,000/qt (95,000/L). These calculations were based on subsamples of a pool of water-hardened eggs taken from no less than five females. Many factors affect egg size, and variability as high as 30% may be observed from batch to batch.

Sauger eggs are often very adhesive both prior to and just after water is added, forming clumps much more readily than walleye eggs. We found that a solution of protease (Sigma Chemical Co., St. Louis, MO, Product No. P-4630) can be used very successfully to break up the clumped eggs. The 0.1% (1 g/L) solution, added to the eggs 3 min after fertilization, breaks down the clumps within 5 min. The eggs are then rinsed with water and are no longer adhesive.

As one might expect from the comparative sizes of the eggs, larvae derived from sauger eggs (sauger and the reciprocal cross) are smaller than those of walleye or hybrid walleye. In one study, hatching success for the reciprocal cross was similar to that for purebred sauger (48.0±5.6% and 50.3±5.9%, respectively), both of which were lower than that for the purebred and hybrid walleye (78.0±6.1% and 79.3±5.9%, respectively). We initially attributed this difference to the greater adhesive quality of sauger eggs coupled with our relative lack of experience in worlung with sauger. However, occasional reductions in hatching success of subsequent broods of protease-treated sauger eggs suggest that sauger eggs may be more sensitive to collection and propagation procedures than walleye eggs. Alternatively, innate differences (e.g. fertility, egg maturity, etc.) may be responsible for the differential hatching success.

Pond culture

shortly after hatch (4–16 hr), the fry are stocked into fertilized ponds at a rate of 70–100,000/acre (175–250,000/ha). Just prior to stoclung, small volumetric subsamples are taken from water-filled buckets containing the fry to be stocked. The number of individual fry are counted within each subsample and the resulting fry concentration is used to calculate the number of fry in each bucket, and ultimately the number of fry stocked into each pond. During sampling, water in the stocking bucket is agitated to ensure uniform distribution of the fry.

We attempted to adjust hatchery water temperature to within a degree or two of expected pond temperature at hatch, however, spring weather fluctuations make exact matching of water temperatures an elusive goal. When stocking the fry, water in the stocking bucket is finally equilibrated to pond temperature by partially submerging the bucket and introducing small amounts of pond water into the bucket over the course of approximately 15 min. Fry are stocked at various points around the perimeter of the production pond.

Fingerling production ponds at the Lake Mills hatchery are unlined and range in size from 0.5–1.5 acres (0.2–0.6 ha) with an average depth of 4 ft (1.2 m). Two weeks prior to hatch, the ponds are filled with water from nearby Rock Lake that has been filtered through a 125 micron rotating drum screen. Ponds are then treated with organic and inorganic fertilizers in the following manner. Immediately after filling, 250 lb (114 kg) soybean meal, 10 lb (4.5 kg) phosphoric acid (54% P_2O_5), and 5.6 lb (2.5 kg) urea (46% N) are applied to each surface acre (0.4 ha). Subsequently, ponds are fertilized once per week with 50 lb (22.7 kg) soybean meal, 5 lb (2.3 kg) phosphoric acid, and 2 lb (0.9 kg) urea per acre (0.4 ha). These quantities are general guidelines, and modifications in both the timing and level of fertilization are typically made in response to the phytoplankton and zooplankton populations of specific ponds, which are highly weather-dependent.

Fingerling size is the primary factor taken into consideration when timing pond harvest. Harvest size is usually determined by the disposition of the fingerlings after harvest and the requirements of the end users. Fingerling growth rates are often influenced by pond stocking densities, with lower densities ultimately yielding larger fish. We have found that the habituation of walleye, hybrid walleye, and sauger fingerlings to formulated feed and intensive culture conditions is most successful when fingerlings are harvested at 1.2–1.4 in (30–35 mm) total length. Additionally, the relative condition factor of the fish, together with pond characteristics such as water temperature, dissolved oxygen levels, prey abundance, and macrophyte concentrations, are important considerations when deciding to harvest a

pond. Ponds are usually harvested by drawdown, however when partial harvests are required, capture methods such as fyke nets or light traps can be used successfully.

Pond fingerling production is highly variable for many reasons, and we have not conducted a scientific comparison (with sufficient replicates) on the pond production characteristics between walleye, hybrid walleye and sauger. Our observations suggest that hybrid walleye fingerlings are generally larger and have a higher condition factor than purebred walleye cultured in similar ponds.

The improved growth performance and docile nature exhibited by the hybrid walleye in our initial studies has lead to further studies involving hybridization of walleye. Together with Robert Summerfelt at Iowa State University we are currently undertaking growth studies comparing hybrid walleye produced using broodstock from different geographic origins. Initial observations from this work indicate that there may be performance differences between the various crosses, and that these differences may be important considerations to walleye aquaculturists.

References

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