Induced tank spawning of cobia, *Rachycentron canadum*, and early larval husbandry

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Recently, considerable interest has developed in the culture of cobia, *Rachycentron canadum*, a coastal marine species that has excellent growth rates and is known for its fine taste and reputation as a sport fish (Figure 1). Until the last decade, published literature available on cobia biology and culture methods was limited, but present research has begun to fill the void. Reports of large-scale commercial culture of cobia in Taiwan have provided strong evidence for investigating the feasibility of cobia aquaculture in the United States. Rapid development of cobia aquaculture in Taiwan has led to the growth of commercial culture of cobia in the region. In fact, most of the country’s offshore net-pens were committed to cobia culture by 1999 (Su et al. 2000). However, in the U.S. cobia culture is still in its infancy and research institutions and industry have only begun to initiate large-scale research efforts.

U.S. cobia culture research was initiated in the 1970s when Hassler and Rainville (1975) collected fertilized eggs off of the coast of North Carolina and reared them through the larval stage to 131-day-old juveniles. Cobia culture was not investigated further until the early 1990s. Researchers at University of Southern Mississippi’s Gulf Coast Research Laboratory (USM GCRL) induced females to spawn using human chorionic gonadotropin and attempted to fertilize the eggs using cryopreserved sperm (Caylor et al. 1994). In 1999, researchers at USM GCRL achieved a natural tank spawn and larvae were reared to approximately 14 days post hatching (dph).

Interest in cobia aquaculture at the Virginia Institute of Marine Science (VIMS), Gloucester Point, Virginia stems from observations of rapidly growing fish held in the VIMS aquarium in the early 1990s. In the following years juvenile cobia captured from the wild were held in captivity and trained to accept a prepared food, found to tolerate varying water quality conditions, were hardy to disease, parasites and subsequent treatment and they adapted well to captivity. A new finfish culture facility with recirculating water systems for broodstock spawning and larval rearing was built in early 1999 (Figure 2). By June 2000 investigations to induce spawning, to produce fertile eggs, and to rear larvae through the juvenile stage were initiated at VIMS. This article describes the first successful U.S. effort, to the best of our knowledge, to achieve a hormone induced spawn of cobia, to produce viable eggs, to rear larvae to juveniles, and to rear cobia spawned in captivity to potential market size.

**What is a cobia?**

Cobia are large migratory fish found in tropical waters around the world, except on the U.S. Pacific Coast (Briggs 1960). On the U.S. Atlantic Coast, cobia range from the Gulf of Mexico to Massachusetts (Shaffer and Nakamura 1989). Cobia migrate to the Chesapeake Bay to feed and spawn in late May and stay until October when they migrate to their wintering grounds around the Florida Keys (Franks et al. 1999). Cobia are opportunistic predators that feed on a wide...
variety of organisms including fish, crabs and other crustaceans and squid. Cobia spawn multiple times throughout their spawning season, which is late spring to late summer/early fall, and release batches of eggs of several hundred thousand to a few million eggs (Lotz et al. 1996, Brown-Peterson et al. 2001). Over the course of a single spawning season a female cobia may release up to 10-20 million eggs in the wild. Cobia can reach large sizes and live over 10 years. In the Chesapeake Bay, females can reach weights over 45 kg, while males rarely exceed 20 kg (Richards 1967).

**Broodstock Acquisition**

To collect broodstock, we enlisted the aid of recreational cobia anglers who fish the lower Chesapeake Bay. Broodstock were collected by hook-and-line during the first week of June 2000 when cobia arrived from their wintering grounds. Fish were collected from a popular cobia fishing site in the lower Chesapeake Bay near Hampton, Virginia.

Because the fishing effort was concentrated in one area, we were able to maintain radio contact with the cobia “fleet” from our broodstock transport vessel. After landing a cobia, the angler would contact us and we would collect the fish soon after capture. Fish were then transferred from the angler into a 1,000 liter aerated transport tank aboard our transport vessel. We could safely transport two to three fish from the fishing grounds to VIMS in 1.5 to 2 hr. During transport the fish were very docile and experienced minimal stress or physical damage. At VIMS the fish were held in 4,500 liter flow through tanks until they were transferred to the spawning tanks.

**Spawning and rearing**

Nine fish were transferred to the 28,500 liter recirculating spawning system. Before transferring the fish, they were anesthetized and catheterized to determine presence and state of ova and milt. Both sexes were then implanted with Ovaplan™ (Syndel International, Inc.), which is a slow release pellet containing 150 µg of salmon GnRHa. Of the nine broodstock fish, we were able to inject four females and one male. The average size of the four injected females was 9 kg. The one male that was injected weighed 14.7 kg. The other four were transferred directly into the spawning tank. Once the fish were injected, eggs were expected in four to seven days.

Water flow in our spawning system was adjusted to take water from the surface of the tank and allow the water to flow into an egg collection barrel plumbed to the spawning tank. A 500 mm mesh plankton net was positioned inside the egg collection barrel below the inflow from the tank, but above the water level in the collection barrel. This configuration permitted the collection and concentration of buoyant eggs released within the spawning tank. Water was collected from the York River at Gloucester Point and was filtered before use, with salinity adjusted to 28 ppt and temperature at 25°C for the spawn.

Approximately 36 hours after injection with the hormone, eggs were discovered over the following two days. Mean egg diameter was 1.42 mm (n = 104, Figure 3). Fertilized eggs hatched in approximately twenty-four hours at 26°C and 28 ppt. Fertilization was estimated at 30 percent.

Eggs were stocked into a larval rearing system outfitted with four 280 liter black conical tanks plumbed to a common filtration system containing solid, chemical and biological filters, as well as an ultraviolet sterilization unit. We exceeded the stocking limits of our rearing facility in an attempt to hatch every egg collected. The high initial stocking densities of 160-2600 eggs/l likely contributed to nearly complete mortality of larvae in the system. Additional larvae were stocked in a 4,500 liter recirculating system, which had an estimated 2000 larvae at 4 dph (days post-hatch). A total of 69 fish survived to 45 dph in the system. We learned the hard way how important it is to stay within the stocking limits of the facility. In future efforts we intend to stock at a density of 5-10 eggs/l in tanks of 1000 liters and larger. We saw no evidence of cannibalism, but reports from Taiwanese pond larval culture indicate otherwise.

Newly hatched larvae measured 3.52 mm (all length measurements are mean standard length), lacked eye pigmentation, had a single median finfold and their mouths had not opened (Figure 4). Water temperature and salinity were maintained at 26°C and 28 ppt, respectively, for the duration of larval rearing. Overhead fluorescent lighting was provided for the black conical tanks and larvae in the 4500 liter tanks were exposed to the natural photoperiod. Water was static for the first 12 days and gentle aeration was provided throughout the larval stage. Ammonia, nitrite, nitrate, pH and alkalinity were monitored and water changes were performed daily until low-flow water circulation was initiated. Water flow was increased as the larvae grew and their swimming ability improved.

Egg yolk reserves supplied sufficient energy reserves until 3 dph, when larvae were 4.4 mm long (Figure 5) and began feeding on ss-rotifers nutritionally enriched with Aquagrow™ Advantage (Martek Biosciences Corp.) stocked at densities of 5-10/ml twice per day. Additionally, copepod nauplii were also offered at 1-2/ml depending on availability through 14 dph. Rotifers were offered through day 11, and beginning 8 dph, newly hatched Artemia nauplii were supplied at densities of 0.5-2/ml two times per day. By 11 dph, 1-day-old Artemia nauplii were exposed to the natural photoperiod. Water temperature and larvae in the 4500 liter tanks were maintained at 26°C and 28 ppt, respectively, for the duration of larval rearing. Overhead fluorescent lighting was provided for the black conical tanks and larvae in the 4500 liter tanks were exposed to the natural photoperiod. Water was static for the first 12 days and gentle aeration was provided throughout the larval stage. Ammonia, nitrite, nitrate, pH and alkalinity were monitored and water changes were performed daily until low-flow water circulation was initiated. Water flow was increased as the larvae grew and their swimming ability improved.

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Juvenile rearing and growth

At 35 dph fish were weaned to a transitional diet of frozen mysid shrimp and, subsequently, to a crumble of 3 mm pellets. Weaning is a critical step in the culture of a species, because it eliminates the need for labor intensive culture of live zooplankton. Juveniles were fed 6 mm and 10 mm pellets as they became able to handle and ingest the larger pellet sizes. Juveniles attained an average size of 1.7 kg in approximately nine months. Subsequently, an overnight system failure resulted in severe oxygen stress, killing all but five fish. One of the surviving fish reached 3.72 kg in just under one year. Additionally, initial feedback from U.S. consumers and seafood restaurant industry was very favorable regarding the taste of these cultured fish.

Summary

To the best our knowledge, we have produced the first juvenile cobia reared from a hormone induced tank spawn and raised to market size in the U.S. Larval rearing methods are apparently similar to methods for most marine fish, inasmuch as larvae were fed rotifers, copepod nauplii and Artemia nauplii. A major hurdle that was overcome in this project was weaning the juvenile cobia from zooplankton to a commercially available pellet. Rapid growth rates and favorable consumer opinion of cultured cobia are positive indicators of economic potential. Additionally, we found that cobia are suited for culture in recirculating systems and can, therefore, be cultured in temperate regions where winter water temperatures drop below optimal levels for these warm water fish.

Initial research at VIMS has helped spark increased interest in the development of cobia aquaculture in the U.S. Research and production strategies addressing specific needs for cobia production are needed to further define captive spawning requirements, optimize larval nutrition and husbandry, improve weaning protocols, and define nutritional requirements for juvenile growout (Rickards 2000). As these biological questions are answered, legal, economic and marketing considerations also must be addressed to ensure that cobia culture can be conducted profitably on a commercial scale.

Notes

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2Mention of trade names does not constitute endorsement.

Acknowledgments

This is contribution No. 2430 of the Virginia Institute of Marine Science, Gloucester Point, VA 23062. Personal communications were received from James S. Franks, USM GCRL, and John Olney, Sr. VIMS.

References