# National initiative for aquaculture development and fishery enhancement of cobia, *Rachcentron canadum*

**State:** SC

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**ABSTRACT**: This multi-disciplinary national project has direct relevance to a number of NOAA goals. First, this project is designed to develop culture technologies to support marine aquaculture by demonstrating production of juvenile cobia to supply land-based controlled intensive culture systems as well as net-pen rearing systems. Second, project research will gather information for the sustainability of healthy marine fish populations while simultaneously advancing the science of stock enhancement. Third, planned genetic activities will identify molecular tools, and procedures for monitoring environmental and wild population impacts of marine aquaculture. Planned education and outreach efforts support NOAA's commitment to public education on the benefits of marine aquaculture. In fact, timely dissemination of findings is a key objective of the project team. Project activities will be conducted in an environmentally responsible manner and the technological aspects will focus on development of environmentally sustainable techniques and protocols.

**ACCOMPLISHMENT TO DATE**

**Hatchery Production**: Identification of spawning technologies for wild and cultured broodstock are a prerequisite for commercial aquaculture development and stock enhancement. In SC, substantial effort focused on collection of wild adults during spring 2007, when the cobia aggregated in inshore coastal sites. Hook and line fishing by staff and live donations from anglers yielded 23 adults (15 males and 8 females) for hatchery use. At capture, female oocyte diameters ranged from 513 – 832 µm and males were typically running ripe. These recently collected adults were held in tanks at the Waddell Mariculture Center (WMC), Bluffton, SC. The outdoor 6.1 m diameter x 1.1 m deep cylindrical fiberglass tanks received flow-through water from the Colleton River at a rate of 40 L/minute (exchange rate 1.75 tank volumes/day). Fish readily adjusted to captivity and consumed natural feeds.

The spawning studies were aimed at examining the relative efficacy of two hormone treatments, hCG and GNRHa, for tank-spawning recently captured cobia. A number of comparative studies were conducted which also examined dose levels of the two hormones. Although 9.5 million eggs were produced during the spawning trials, results were variable and did not identify the more efficacious hormone or dose level. In some cases, non-hormone treated females spawned volitionally and produced eggs with high fertility. In general, it appeared that best hatchery performance (spawning and fertility) occurred among newly captured fish regardless of hormone treatment. However, as captured wild fish remained in captivity, subsequent viable spawns were more likely to be induced using GNRHa rather than hCG. Further studies are planned during 2008 to continue evaluating the efficacy of hCG and GNRHa to induce spawning in recently captured wild cobia.

Spawning studies were also conducted at the University of Texas, Marine Science Institute (UTMSI) in Port Aransas. Work focused on use of cultured broodstock. The F1 cobia broodstock held in tanks spawned from June through December at approximately two-week intervals for 18 spawning events. The largest female spawned 12 times with 88% viable eggs, and a second female spawned 7 times with 75% viable eggs. Eggs were collected for evaluating egg quality through measures of lipid, fatty acids, protein and amino acids. This work is ongoing.

**Nursery production**: A number of studies have been completed in SC and TX. Work in SC focused on pond-nursery systems while studies in TX investigated intensive tank-rearing systems. In SC, pond nursery trials were conducted at WMC examining various stocking densities while holding time to harvest in the range of 18-22 days. In each trial, cobia larvae from a single spawning event were stocked into replicate 0.25 ha or 0.10 ha ponds. General procedures included stocking 2-3 day old larvae in the morning hours.

Results indicated that stocking densities of 180,000 – 220,000 larvae/ha yielded survival levels of 21 to 36%, while stocking at higher densities (360,000 – 700,000 larvae /ha) provided substantially lower survival levels (<11%). At the lower densities, fish grew to ~65 mm TL during 18-24 days at 30 C.

Two tank-nursery production trials using larvae were conducted in TX using recirculating aquaculture systems (RAS). Initial density of newly-hatched larvae in rearing tanks ranged from 9-15/L but final densities at 28 days-post-hatch (dph) were 1/L. It is believed production can be improved by increasing the number of feedings of live prey per day. Testing this modified feeding schedule is planned.

During juvenile growout in RASs, cobia reached 4 g at 43 days and 35 g at 71 dph, matching weights achieved in pond growout. Survival averaged 76.6% in the first phase (43 d) and 92.5% for the second phase (71 d). These results show that juveniles can be successfully cultured to 35 g in RAS with similar growth and survival as obtained in outdoor systems.

Older cobia juveniles (76 dph; 6.7 ± 0.2 g) grown at three different densities (4 reps/density) grew well and had high food conversion efficiencies in RAS. Water temperature was held at 27 ± 1 C and salinity was 32.0 ± 3.0 g/L. Fish were fed to satiation twice daily with a commercial diet. Survival was high and there were no significant differences among treatments. Growth was also not significantly different among treatments with weight gains of 2,523 to 2,747% of initial weight (SGR ranging from 5.18 to 5.29). Feed efficiency (0.96 ± 0.02) of the 0.04 g/L control treatment was significantly better than that of the 0.22 g/L treatment (1.04 ± 0.03) (Table 1).

Table 1. Mean responses (± S.E.) of juvenile cobia reared for ten weeks at initial densities of 0.04, 0.22, and 0.44 g of fish/L in RAS in Texas. Mean values are from five replicates of fish per treatment.

| Treatment Init. density (g/L) | Final density (g/L) | Survival (%) | Total Weight Gain (%) | Feed efficiency (g gain/g fed) |
|---|---|---|---|---|
| 0.04 | 1.23 (0.06) | 96 (4) | 2747.1 (181.2) | 0.96 (0.02) |
| 0.22 | 6.19 (0.27) | 98 (2) | 2743.4 (162.6) | 1.04 (0.03) |
| 0.44 | 11.37 (0.42) | 98 (2) | 2523.9 (72.80) | 1.02 (0.09) |

The demonstration of grow-out performance of large juveniles (250-300 g) in land-based intensive culture systems is planned at Harbor Branch Oceanographic Institute, FL during 2008. Similarly, work to evaluate our ability to enhance the human health attributes of farmed cobia through dietary manipulation is planned at the Hollings Marine Laboratory, Charleston during 2008. This work will also focus on large juveniles.

**Shipping parameters for juveniles**: Interest in cobia culture has shown significant growth in recent years but few hatcheries are available to support this developing industry. To facilitate the transport of cobia between facilities, four-24 h experiments were conducted in NH to examine the effects of density, temperature, and actual versus simulated transport on juvenile cobia (1.5-3.0 g) survival.

Fertilized cobia eggs from UTMSI were shipped to Great Bay Aquaculture LLC (GBA), Portsmouth, NH. Simulated shipping trials were initiated in October and November 2006. The 60-dph juveniles (1.5-3.0 g) were starved for 24 h prior to stocking them polyethylene bags containing filled with 30 L filtered sea water (26 g/L) in styrofoam coolers (42.5 cm H x 71.1 cm L x 46.9 cm). To stabilize pH during the trials, Trizma Type 8.3 Buffer and Trizma Type 7.4 Buffer were added to reach a final concentration of 1.9 g/L each. Ammo Lock was added to mitigate ammonia toxicity and Stress Coat to minimize handling stress were added to achieve final concentrations of 130 and 260 g/ml, respectively. Air space in the shipping bags was filled with gaseous oxygen and the bags were sealed in cardboard boxes. During the 24 h in-lab simulated shipment, the boxes were held at GBA (12-18 C) and gently shaken for 10 sec at 120 min intervals. The actual transport study involved trucking boxes to and from a bus terminal and transport by local bus for 8 hours. After the 24 h shipping study, surviving fish were placed in aquaria (temperature within 2 degrees of transport temperature) for 24 h during which they were fed and mortality assessed.

Results indicated that mortality during actual transport at fish densities of 5, 10, and 15 kg/$m^3$ (2.9 ± 0.6, 2.9 ± 1.8, and 6.3 ± 0.8%, respectively) did not differ by treatment, but was significantly higher than simulated transport at each density (no mortality). No differences in mortality were found following simulated shipping at 19, 21, and 25 C at 15 kg/m3. Significantly greater mortality occurred, when juveniles were packed at 25 kg/$m^3$ (10.4 ± 0.7%) than 20 kg/$m^3$ (1.9 ± 1.6%) and 15 kg/$m^3$ (0.1 ± 0.1%). Recovery and survival following simulated and actual shipping was high in all treatment groups. Under the conditions examined, results indicate that transport density of small juveniles should not exceed 20 kg/$m^3$.

In addition to the well controlled study in NH there were shipping studies conducted with cobia shipped from SC to VA and also from FL to VA. These studies suggest that commercially air-shipping eggs can result in high survival while shipping newly hatched swimming fry via ground transport results in high mortality. However, it may not be the mode of shipment which was important but rather the life stage. Transport of larger juveniles (~80 mm TL) via truck can be very successful if density is relatively low (4 g/L). Additional studies are planned to help identify appropriate shipping parameters.

**Genetic studies**: Studies are underway to genetically characterize fish captured along the Atlantic coast to define population structure. The genetic analyses are being conducted in SC at the Hollings Marine Laboratory. Currently 10 cobia microsatellite loci were selected from those described by Renshaw et al. (2005) based on reported conformity with Hardy-Weinburg equilibrium, degree of polymorphism, locus characteristics (di-, tetra- and complex repeats). These loci have been built into three multiplexed panels and are being used to genotype tissue samples (Table 2). Approximately 430 genetic samples have been collected from fish captured in SC and VA waters.

Table 2. Current multiplexed microsatellite panel fragment lengths (bp) and number of alleles.

| | | |
|---|---|---|
| 1st panel: | | |
| Rca1B-E02 | (CT)18 | 298-314 bp with 7 alleles |
| Rca1-H10 | (CA)16 | 119-139 bp with 8 alleles |
| Rca1-A04 | (CA)9(CACT)4 | 196-206 bp with 6 alleles |
| Rca1-H08 | (GT)30 | 273-299 bp with 9 alleles |
| 2nd panel: | | |
| Rca1B-D10 | (CTAT)15 | 143-223 bp with 17 alleles |
| Rca1B-H09 | (GATA)31 | 176-224 bp with 12 alleles |
| Rca1-C04 | (GT)17 | 223-253 bp with 10 alleles |
| Rca1-H01 | (CA)37 | 275-311 bp with 12 alleles |
| Rca1B-C06 | (GATA)29 | 340-404 bp with 13 alleles |
| 3rd panel: | | |
| Rca1-E11 | (CA)12 | 167-181 bp with 7 alleles |
| Rca1-A11 | (GT)24 | 167-201 bp with 15 alleles |
| Rca1B-E08A | (CA)3GA(CA)5A(CA)16 | 181-225 bp with 5 alleles |
| Rca1-F10 | (CA)2CG(CA)12CG(CA)4 | 287-297 bp with 5 alleles |

**Fishery enhancement research**: The stock enhancement research evaluating both season and size-at-release on recapture of stocked fish is being conducted in SC and VA. In SC, fish have been released on 5 occasions at different sizes in spring, summer and fall while VA researchers are planning to stock in spring 2008 when the cobia have grown to their larger target stocking size.

During 2007 in SC, 53,305 juvenile (~60-130 mm TL) cobia were released in the adjacent Colleton River in Bluffton, source of the adults (Table 3). The first group comprised of large fish (810 mm TL) reared in tanks at MRRI while the other juveniles were grown in tank and pond nursery systems at WMC. Evaluation of impacts will occur during the next few years when the juveniles return as adults.

Table 3. Cobia stocking efforts in SC during 2007.

| Release | Release | Age | Juveniles | TL | Tag Type |
|---|---|---|---|---|---|

| Date | Location | (d) | (n) | (mm) | |
|---|---|---|---|---|---|
| 6/20/2007 | Colleton River | 770 | 41 | 809.6 | nylon dart |
| 6/28/2007 | Colleton River | 21 | 28,363 | 63.1 | genetic |
| 7/11/2007 | Colleton River | 34 | 5,485 | 101.1 | genetic |
| 7/24/2007 | Colleton River | 36 | 16,264 | 100.8 | genetic |
| 8/3/2007 | Colleton River | 46 | 3,152 | 127.3 | genetic |

**Education and Outreach**: Results have been disseminated in numerous local media, to local angler organizations, fishery managers, and to other researchers. In SC in particular, cobia support important seasonal local fisheries and anglers are especially interested in keeping informed of findings. During 2007, a number of anglers have recommended tightening of harvest regulations to assure conservation for this species. Project staff has made a number of presentations in the special sessions on cobia and stock enhancement at the Aquaculture America (World Aquaculture Society) Meeting in San Antonio, Texas, March-April 2007. Similarly, a number of presentations are planned for the Aquaculture America Meeting to be convened in FL, February 9-12, 2008.

**Summary**: Substantial progress has been achieved is all program aspects thereby improving the likelihood of economically viable aquaculture in the US. Similarly, new information is being developed to assist in management of wild cobia fisheries.