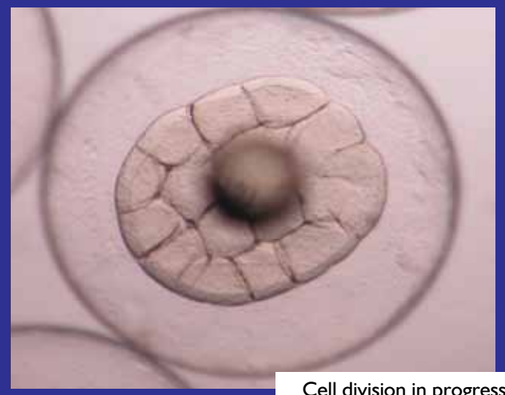
generally started feeding at 3 dph and they can be fed with the enriched rotifer (*Brachionus rotundiformis*) at the rate of 10-12 nos / ml, two times a day till 10 dph. From 8 dph, the larvae can be fed with enriched Artemia nauplii at the rate of 5-6 nos / ml, 2 times a day. During the rotifer and Artemia feeding stage, green water technique can be used in the larviculture system with the microalgae *Nannocloropsis occulata* at the cell density of $1x10^7$ cells / ml. The Artemia nauplii were provided at a density



Cell division in progress

of 5-6 nos./ml up to 19th day. Weaning to larval inert feed was started from 15th day and co-feeding with Artemia was continued till 19th day. While weaning, formulated feed were given 30 minutes prior to feeding with live feed. Frequent grading is needed from this stage to avoid/reduce cannibalism. Every

Newly hatched larvae

Metamorphosed fingerlings of cobia

day grading is advisable for better survival. In addition, variety of other factors such as tank colour, size of the tank, water temperature, water quality, etc., may also affect the larval survival and growth. From 20th day, the feeding was entirely on inert larval feeds. Size of the artificial feed has to be smaller than the mouth size of the fish. Continuous water exchange was required during weaning stage. The metamorphosis of the larvae started from 18th day and all the larvae metamorphose into juveniles by 21st day. The water exchange is practically nil till 7th day and it can be gradually increased from 10-100 % from 8th to 25th day after hatching. The environmental conditions required during the larviculture period were DO: > 5mg/l; $NH_3$: < 0.1mg/l; pH: 7.8 – 8.4; salinity: 25-35 ppt and water temperature : 27-33° C.

## Nursery Rearing

Nursery rearing was carried out from 25-55th day. During this stage, the fingerlings was initially provided with artificial feed of 800$\mu$ size. Thereafter, the fingerlings were fed with progressively higher size range of floating extruded larval feeds. Daily water exchange of 100% is advisable. Water quality parameters like salinity, temperature, pH, oxygen level and ammonia were closely monitored during the entire larviculture period. After 55th day after hatching, fingerlings with size range from 3-4 inch size can be supplied to farmers for stocking in the sea cages / ponds for further nursery rearing and grow-out farming.

Consequent to the first successful spawning, continuous breeding and seed production experiments were successfully carried out. Optimization of cobia seed production through maintaining appropriate densities of algae, rotifer and newly hatched larvae were also carried out.

## Consultancy Services Offered by CMFRI:

Site selection
Hatchery Designing
Hatchery Operation & Training of Staff
Preparation of Bankable Project Report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CMFRI Pamphlet No: 21/2014


# BROODSTOCK DEVELOPMENT & SEED PRODUCTION OF COBIA

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Mariculture of marine finfish has been growing rapidly on a global basis especially with the development and expansion of sea cage farming. One of the major reasons for the growth of sea cage farming is the availability of breeding techniques that can produce sufficient quantity of seeds of different high value marine finfish. Many countries in the Asia-Pacific Region like Australia, China, Japan, Taiwan, Philippines, Indonesia, Thailand, Malaysia and Vietnam have made substantial progress in the development of commercial level seed production technologies of high value finfish suitable for sea farming.

Cobia, *Rachycentron canadum*, is rapidly gaining importance in many Asian countries as an excellent candidate species for aquaculture due to its fast growth rate, adaptability for captive breeding, low cost of production, good meat quality and high market demand especially for sashimi industry. Cobia is distributed worldwide in warm marine waters. They are found throughout the water column and are caught in both coastal and continental shelf waters, although they are typically considered to be an offshore species. Under culture conditions, cobia is reported to reach 5-7 kg in body weight in 8-12 months and 10-14 kg in two years. Sexual maturity is reported in males at 1-2 years and in females 2-3 years.

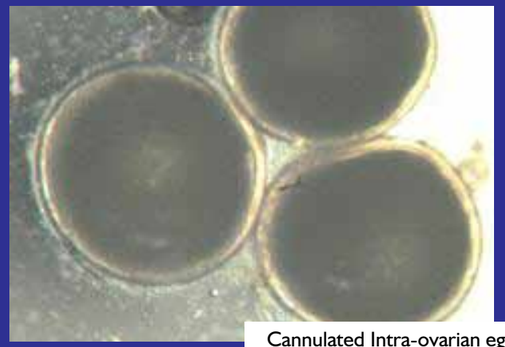
## Broodstock Development

The Mandapam Regional Centre of CMFRI initiated research on seed production of cobia during the year 2008. The Centre has succeeded in developing protocols for captive breeding, seed production and cage farming of cobia. Sub-adult cobia were collected from wild and stocked in sea cages for development as broodstock. They were fed with squids, oil sardines and lesser sardines with vitamin premixes. The fishes were cannulated and sexed. PIT (Passive Integrated Transponder) tagging was done for identification of the brooder. It is a radio frequency device to permanently mark the fishes internally. The PIT tag contains a microprocessor chip and antenna. The implant site depends upon the species, size of the fish and the size of the tag. It is preferable to implant the tag on the dorsal musculature of the fish which will be convenient for the brood fishes to be read. Fishes weighing around 9 kg and above, were transferred and stocked in 60 tonne capacity FRP tanks / 100 tonne capacity cement tanks with recirculation system in an on-shore hatchery facility at the male: female ratio of 2:1. Then, these fishes were provided with special maturation diets *viz*., squids, cuttlefish, crab, shrimps and chopped oil sardines once in a day.

Broodstock cages at Mandapam

Broodstocks of cobia

Cannulation close-up view



Cannulated Intra-ovarian eggs

## Induced Spawning

Cannular biopsies were periodically taken to assess ovarian maturation. Spawning can be obtained either naturally or by inducing with hormones. Induced breeding is commonly practiced in most commercial hatcheries. The hormonal treatment is intended to trigger the last phases in egg maturation, i.e. a strong egg hydration followed by their release. However, if eggs have not reached the late-vitellogenic (or post-vitellogenic) stage, the treatment does not work; hence ovarian biopsy is essential for assessing the ovarian development. Usage of different hormones namely Luteinizing Hormone-Releasing hormone (LHRHa) and Human Chorionic Gonadotropin (HCG) were studied at different dosage levels to standardize the optimum dosage. Once the ova reach a size of 700 $\mu$m diameter, the females were induced with HCG at the dose of 500IU/kg body weight. The males are administered with a dosage of 250IU/kg body weight. The spawning occured within 36 hours after injection. The number of eggs spawned by cobia ranges from 0.4 to 2.5 million. The fertilized eggs which were floating at the surface were collected by using a 500 $\mu$ mesh and incubated. The unfertilized eggs which settle at the bottom were removed by siphoning. The fertilized eggs were incubated in 2 tonne capacity rectangular / circular tanks. Stocking density can be maintained at a moderate level of 200 to 500 eggs per litre. The development of embryo can be observed at frequent intervals under a stereo / compound bionocular microscope. The hatching had taken place between 18 to 22 hours. Before stocking of the newly hatched larvae into larviculture tanks, at least 10 to 20 larvae were checked under microscope for deformation / abnormalities, pigmentation and appearance of internal organs.

Administration of hormones for Final oocyte maturation and spawning

## Cobia Larviculture

The newly hatched cobia larvae measure around 3.4 mm and were stocked in 2 tonne capacity tanks containing filtered seawater at a stocking density of 5-10nos / litre. The tanks were provided with mild aeration and microalgae at a density of $1x10^7$ nos./ml. Special care is needed when selecting microalgae for on growing live feeds for marine fish larvae, in order to avoid the nutritional deficiencies of the latter especially in terms of n-3 highly unsaturated fatty acids. Deficiencies in the n-3 PUFA contents of microalgae may cause severe mortalities and quality problems in marine fish larvae. The mouth of the cobia larvae opens on 3$^{rd}$ day and the mouth size was around 230 $\mu$m. Newly hatched cobia larvae

Fertilized eggs collected on 500 micron mesh